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IQRPE Integrity Assessment Plan for the 242-A Evaporator System and PC-5000 Process Condensate Transfer Line

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Abstract: This plan, written by the Independent Qualified Registered Professional Engineer (IQRPE), contains the requirements for an independent assessment of the waste-handling system integrity of the 242A Evaporator facility. It is required so that an independent assessment can be made of the 242-A facility n accordance with WAC 173-303-640. Previous assessments of the 242A facility were completed in 1993 and 1998. This assessment is reuquired by the 242-A Dangerous Waste Permit (WA 7890008967).

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Independent Qualified Registered Professional Engineer

CH2M HILL Requisition No. 144001

IQRPE Integrity Assessment Plan

for the

242-A Evaporator System
and
PC-5000 Process Condensate Transfer Line

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Table of Contents

Tables

Figures

Attachments

1.0 INTRODUCTION

Portions of the 242-A Evaporator System at the Hanford Site must be assessed to meet the requirements of the Permit WA 7890008967 under the Washington State Department of Ecology (Ecology) Dangerous Waste Regulation, Washington Administrative Code (WAC) 173-303-640 (WAC 2004). The assessment is limited to the provisions of Section 173-303-640(2) for assessment of existing tank system's integrity. Unless otherwise stated, an "existing tank system" in this Integrity Assessment Plan (IAP) is a tank system which is currently in use at the time the integrity assessment is being conducted.

The categories of tanks that are being assessed at the 242-A Evaporator treatment, storage, and disposal (TSD) unit are aboveground tanks (vapor-liquid separator, reboiler) and on-ground tanks (condensate collection tank and condensate filters) as per WAC 173-303-640(2)(c) and Publication No. 94-114 (Ecology 1994).

The categories of ancillary equipment that are being assessed at the 242-A Evaporator TSD unit are PC-5000 transfer line, vacuum condenser system, all piping , pumps, seal pot, flanges, and couplings as per WAC 173-303-640(2)(c)(v)(B).

The assessment will also include secondary containment sumps, drain lines, and leak detection systems for the 242-A Evaporator as per WAC 173-303-640(4) and Publication No. 95-420 (Ecology 1995). This Integrity Assessment Plan (IAP) is organized as follows:

- Section 1—Description of the project, integrity assessment requirements, and past assessment activities.
- Section 2—Description of the project scope, including the objectives of the integrity assessment, the boundaries of the investigation, activities excluded as part of the assessment, and the deliverables to be prepared for the project.
- Section 3—Description of the process flow, the subsystems associated with the process, the characteristics of the wastes handled by each of the subsystems, and the operating parameters for each of the subsystems
- Section 4—Design and operating information, including the design codes and standards that the system was designed to; the original basis of design; structural support features of the system; existing waste compatibility information; existing pressure control information; existing secondary containment features; ancillary equipment associated with each subsystem; existing corrosion protection measures; and ongoing inspection activities.
- Section 5—Integrity testing methods and requirements for visual inspection, non-destructive (ultrasonic) testing, and hydrostatic testing.
- Section 6—Assessment report scope, with respect to the applicable codes, standards, and regulations; the original basis of design; applicable structural design standards; waste compatibility; pressure control; secondary containment; ancillary equipment; corrosion protection; and the basis for future recommended inspections in order to meet the requirements of the WAC Independent Qualified Registered Professional Engineer (IQRPE) requirements.
- Section 7—Integrity assessment report certification statement description.
- Section 8—References.

1.1 Project Description

The 242-A Evaporator started waste management operations in March of 1977 (Ecology 2004a). The 242-A Evaporator is located in the 200 East Area and is used to treat mixed waste from the Double-Shell Tank (DST) System by removing water and most volatile organics (approximately 20 to 90 percent of the water based on historical process data is removed during evaporation along with a portion of volatile organics). Two liquid waste streams leave the 242-A Evaporator following the treatment process. The first stream, a concentrated slurry, is pumped back into the DST System. The second waste stream, process condensate (comprised of the water and volatile organics removed from the mixed waste during the evaporation process), is routed through condensate filters before release to a retention basin (the Liquid Effluent Retention Facility [LERF]). The process condensate is sent to the LERF via the PC-5000 Transfer Line to await further treatment at the 200 East Effluent Treatment Facility (ETF). Off-gases from the process are routed through a de-entrainment unit, a pre-filter, and high-efficiency particulate air filters before being discharged to the environment. These emissions are regulated under 40 CFR Part 264, Subpart AA. The 242-A Evaporator is permitted to treat up to 870,642 liters (230,000 gallons) of mixed waste per day. The typical feed flow rates are 340 to 530 Liters per minute (90 to 140 gpm).

The 242-A Evaporator System will be assessed as four major subsystems. The four subsystems are as follows:

- Vapor-Liquid Separator Subsystem
- Condensate Collection Subsystem
- Building and Secondary Containment Subsystem
- PC-5000 Transfer Line Subsystem

These four subsystems store, transport, or treat Washington State Dangerous Wastes. Detailed discussions of these subsystems are provided in Section 3.0.

1.2 Integrity Assessment Requirements

This integrity assessment will confirm that the 242-A Evaporator system is adequately designed and has sufficient structural strength and compatibility with the wastes to be treated, and will ensure that it will not collapse, rupture, or fail as required by WAC 173-303-640(2) requirements for existing tank systems. This assessment will be reviewed and certified by an Independent, Qualified Registered Professional Engineer (IQRPE) in accordance with WAC 173-303-810(13)(a).

The 242A Tank System includes the PC-5000 transfer line, which runs between the 242-A Evaporator and the LERF. This line is included in the 242A "Ancillary Equipment" and is subject to dangerous waste regulations for existing tank systems including ancillary equipment. The assessment of the integrity of the PC-5000 Transfer Line as a part of this project is a requirement of the WAC 173-303-640(2).

1.3 Previous Integrity Assessment Requirements

An integrity assessment report for the 242-A Evaporator System conducted in 1993 (WHC 1993a) found that the system was not leaking and fit for use. However, based on the results of the integrity assessment, age of the tank system, materials of construction, and the characteristics of the waste treated in the system, the 1993 IAR established a repeat integrity assessment frequency of five years/8,000 hours of operation between interim integrity assessments. The basis for the five year/8,000 hour frequency is that the 242-A Evaporator has an inherent corrosion protection, stringent operational controls, and aggressive preventative maintenance programs in place.

An integrity assessment (IA) of the 242-A Evaporator System conducted in 1998 (LMHC 1998b) found that the system was not leaking and was fit for use. The 1998 IAR recommended that the next TSD unit integrity assessment be performed no later than July 15, 2008. This recommendation was based on ultrasonic (UT) testing results indicating the "minimum remaining life" for all of the equipment tested was greater than 20 years, with the exception of the E-C-1 condenser. The UT testing results for the E-C-1 condenser showed that this equipment had a minimum projected remaining life of greater than 13 years.

The following equipment was upgraded after the 1998 integrity assessment.

- Replacement of E-C-2 Intercondenser in 2004
- Replacement of E -C-3 Aftercondenser in 2004

It is not known whether E-C-2 and E-C-3 were integrity assessed or tested prior to installation. This information will be determined during the preparation of the IAR. An IA was conducted for the PC-5000 transfer line in 1993. At the time of the PC-5000 IA, the PC-5000 transfer line was part of the LERF Treatment Storage and Disposal (TSD) facility and a follow up IA was not required by the LERF Part B RCRA Permit. The 1993 IAR for the PC-5000 transfer line (WHC 1993c) concluded that the PC-5000 transfer line had sufficient strength and compatibility with the wastes and would not collapse, rupture, or fail during its service life based on the review of procurement specifications and design standards, construction quality control inspections, and pressure testing of each segment of the pipeline and assembled systems prior to installation.

2.0 SCOPE

This section describes the scope of the integrity assessment for the 242-A Evaporator System, which includes the PC-5000 Transfer Line.

2.1 Objectives

This IAP establishes the basis, inspections, tests, and evaluation procedures required to assess the integrity of the 242-A Evaporator System including the PC-5000 Transfer Line. Execution of the activities prescribed by this IAP will provide the information necessary for the IQRPE to evaluate and certify the integrity of the system components included in the scope of this project.

The integrity assessment described in this IAP is a requirement of the WAC. The basic requirement imposed on the owner or operator is that he "determine that the tank system is not leaking or is unfit for use" (WAC 173-303-640(2)(a)). Upon completion of an integrity assessment that concludes that the tank system is not leaking and is not unfit for use, "the owner or operator must develop a schedule for conducting integrity assessments over the life of the tank..." in accordance with WAC 173-303-640(2)(e). If the "tank system is found to be leaking or unfit for use, the owner or operator must comply with the requirements of subsection (7) of this section" WAC 173-303-640(2)(d).

WAC 173-303-640(2)(c) requires the following:

"Assessment must determine that the tank system is adequately designed and has sufficient structural strength and compatibility with the waste(s) to be stored or treated, to ensure that it will not collapse, rupture, or fail. At a minimum, consideration must be given to the following factors:

- Design standard(s) of construction (if available)
- Dangerous characteristics of the waste(s) that have been and will be handled
- Existing corrosion protection measures
- Documented age of the tank system (if available, otherwise an estimate)
- Results of a leak test, internal inspection, or other tank integrity examination

2.2 Items Included in Integrity Assessment

The following components of the 242-A Evaporator System and PC-5000 Transfer Line are included in the scope of the proposed integrity assessment.

2.2.1 242-A Evaporator System

The boundaries of this system include all associated piping, drains, valves, sumps, secondary containment and tanks which receive, store, accumulate, transfer or treat Washington State Dangerous Waste or waste components within the 242-A Evaporator TSD unit as described in the Permit WA 7890008967. The components to be evaluated for the 242-A Evaporator system during this IA are listed in Table 2.1.

Table 2. 1 Integrity Assessment Components for 242-A Evaporator System

System	Major Components	Sub-Components	Reference
VAPOR LIQUID SEPARATOR SUBSYSTEM			**Section 3.1.2.1**
Waste Feed System	Feed Pipelines (Within the 242-A Evaporator Building)	Feed (transfer) pipe line (3-inch diameter carbon steel) Secondary containment piping (6-inch diameter carbon steel)	Section 3.1.2.1 Figure 3.2
Evaporator Process Loop	Reboiler (E-A-1)	Shell	Section 3.1.2.1.2 Figure 3.2
	Vapor-liquid separator (C-A-1)	Shell Instrumentation Interlocks	
	Recirculation Pump (P-B-1)	Shaft seal Seal water pressure and flow monitoring devices Valves	
	Recirculation Loop	Upper recirculation Loop Lower recirculation Loop	
Slurry System	Slurry pump (P-B-2) Slurry Transfer pipelines (with the Evaporator Building)	Shaft seal Pressure and flow controls Interlock Slurry transfer lines secondary containment Leak detection system Valve Pit Sampler (SAMP-F-2)	Section 3.1.2.1.3 Figure 3.3
CONDENSATE COLLECTION SUBSYSTEM			Section 3.1.2.2
Vacuum Condenser System	Primary condenser (E-C-1) Inter condenser (E-C-2) After condenser (E-C-3) Stream Jet Ejector (J-EC1-1) Stream Jet Ejector (J-EC1 -2)	Condenser Shell Condenser Shell Condenser Shell Stream jet, pressure controller, and air bleed-in valve Stream jet, pressure controller, and air bleed-in valve	Section 3.1.2.2.1 Figure 3.4
Vacuum Condenser System		TK-C-500 Corrosion Inhibitor Tank Vacuum condensate lines	
Condensate Collection Tank (C-100)	Tank Shell	Overflow line and trap Process controls Instrumentation for high –and-low level alarms	
	Process Condensate Pump (P-C-100)	Shaft seal	
	Condensate Filters (F-C-1) & (F-C-3)	Primary condensate filter (F-C-1) steel housing Secondary filter (F-C-3) cast iron housing	
	Process Condensate Radiation Monitoring, Sampling and Diversion System	Monitoring instruments	
	Seal Pot	Shell	
Condensate Recycle System	2-inch pipeline Pump (P-C106) Disposable cartridge filters	Pipe walls Pump flanges and valves Filters (F-C-5 and F-C-6)	
SECONDARY CONTAINMENT AND RELEASE DETECTION SUBSYSTEM			Section 3.1.2.3
242-A Building Secondary Containment	242-A Building Pump Room	Operating Area Secondary containment walls Secondary containment floors Pipe jumpers Seal water leakage collection funnels	Section 3.1.2.3.1 Figure 3.6

242-A Building Secondary Containment		Ceiling cover blocks	Section 3.1.2.3.1 Figure 3.6
	Pump Room Sump	Stream jet Secondary overflow line Instrumentation	
	Evaporator Room	Secondary containment walls Secondary containment floors Floor drain	
	Condenser Room	Secondary containment walls Secondary containment floors Two floor drains	
	Load out and Hot Equipment Storage Rooms	Secondary containment walls Secondary containment floors Two recirculation lines Samplers Drain sump Decontamination sump Leak detectors in the sampler enclosures	
	242-A Building Drain Lines	Pump room sump drain line (DR-334) Vapor-liquid separator vessel drain line (DR-335) Condenser room drain line (DR-343) Diverted process condensate drain line (DR-338) Cathodic Protection system	

2.2.2 PC-5000 Transfer Line

The boundaries of PC-5000 transfer line for the purposes of the integrity assessment include all associated piping, valves, flanges, seams, and secondary containment. The PC-5000 line to be leak tested in this IAP begins at the tie-in to the existing two-inch PC556-M42 line down stream of valve HV-RC3-3, as shown on sheet 2 of drawing no. H-2-98990, 2006, in the 242-A Evaporator building and terminates at approximately line station STA 56+ 47.57 at LERF Basin 43 (Basin 242AL-43) on drawing no, H-2-79614, 1998. Drawing H-2-88766 is a P&ID that shows the pipeline connections and inter-ties. This is a total pipe run of approximately 1669 meters (5475 feet). The components to be evaluated during this IA for the PC-5000 transfer line are listed in Table 2.2.

Table 2. 2 Integrity Assessment Components For PC-5000 Transfer Line Subsystem

System	Major Components	Sub-Components	Reference
PC-5000 Transfer Line	• 3-inch Carrier Pipe • 6-inch Outer Containment Pipe	• Valves • Electronic leak detection elements and test risers • Valve tie-in to PC-556-M42 • Instrument connections at the 242-A Evaporator building	

2.3 Items Excluded from the Integrity Assessment

Piping systems which either introduce liquid waste streams into the building or transfer solids, liquids, or vapors to other facilities will be tested up to but not to include the last valve or flanged connection inside the TSD unit perimeter. The following items are not covered by the WAC dangerous waste regulations or the RCRA Permit for the TSD unit, and are therefore outside of the scope of this certification:

- Vessel Vent Subsystem, except for the seal pot and associated drain lines (Non-Dangerous Waste Subsystem)
- Steam Condensate Subsystem (Non-Dangerous Waste Subsystem)
- Raw Water Disposal Subsystem (Non-Dangerous Waste Subsystem)
- Plant utilities, including chemical supply storage and piping supply systems, instrument and plant air supply lines, and electrical power beyond the first upstream device or uninterruptible power supply systems that do not directly affect the ability of the system to prevent the collapse, rupture, or failure of components handling dangerous wastes.

- Structural features not related to dangerous waste secondary containment.
- Architectural features not related to dangerous waste containment.
- Lighting systems.
- System design features related to protection of the system due to vehicular traffic.
- Electrical or signal lines beyond the first upstream field termination box (FTB), motor control center (MCC), or instrument control panel (ICS). Electrical feed, including wiring, local hand switches, terminations, breakers, and other equipment or instruments located in motor control centers will be reviewed to the extent they affect the ability of the system to prevent the collapse, rupture, or failure of components handling dangerous wastes. Instrument cabling and terminations will also be limited to locally mounted devices and field termination boxes and/or local instrumentation and control panels to the extent they affect the ability of the system to prevent the collapse, rupture, or failure of components handling dangerous wastes.
- Verification of functional logic for operation and control of the system.

This certification also excludes the following aspects of the system as they relate to radionuclide and radiation control as they are outside the scope of the WAC dangerous waste regulations:

- Radiation monitoring or detection components that may be mounted at various locations throughout the system.
- Requirements regarding waste feed radionuclide properties, including all radioactive and radionuclide property considerations.
- Requirements developed to ensure exposure of plant operating personnel to radioactive process streams (radiation) is as-low as reasonably achievable (ALARA)
- System safety features related to the following:
  - Personnel Safety
  - Fire Protection
  - Nuclear Safety

2.4 Deliverables

The deliverables for this project will be two separate IARs: one for the 242-A Evaporator and one for the PC-5000 Transfer Line. Both IARs will include the required IQRPE certification statement. Section 5 of this IAP includes a draft table of contents for the IAR. The IQRPE certification statement is included in Section 7.0 of this IAP. The IAR will include specific conclusions and recommendations regarding the integrity of the system components and use of the system for management of waste materials. The IAR will specifically include a recommendation for the frequency of future integrity assessments.

Specific Techno General Services Company (TGS) IQRPE Inspection reports will be issued to document the following inspections, testing, evaluations, and analyses as they are completed:

- Inspections and walk down reports
- Non-destructive testing results evaluation
- Level draw down leak testing results evaluation
- Design analyses, evaluations, and calculations

- Leak testing results evaluation

The contents of the above inspections, tests, and reports will be included as attachments to the IAR (See Section 5.0). Periodic status reports will also be issued to track assessment progress and budget, and will provide a record of the history of the integrity assessment.

3.0 PROCESS DESCRIPTION

This section provides a description of the process flow, the subsystems associated with the process, the characteristics of the wastes handled by each of the subsystems, and the operating parameters for each of the subsystems. Most of the description, figures and tables are taken from Permit No. WA7890008967, 1993 IAR and 1998 IAR. Section 3.1 describes the 242-A Evaporator System. Section 3.2 provides a description of the PC-5000 Transfer Line.

3.1 242-A Evaporator System

The following subsections describe the process flow, the subsystems associated with the process, the characteristics of the wastes handled by each of the subsystems, and the operating parameters for each of the subsystems associated with the 242-A Evaporator System.

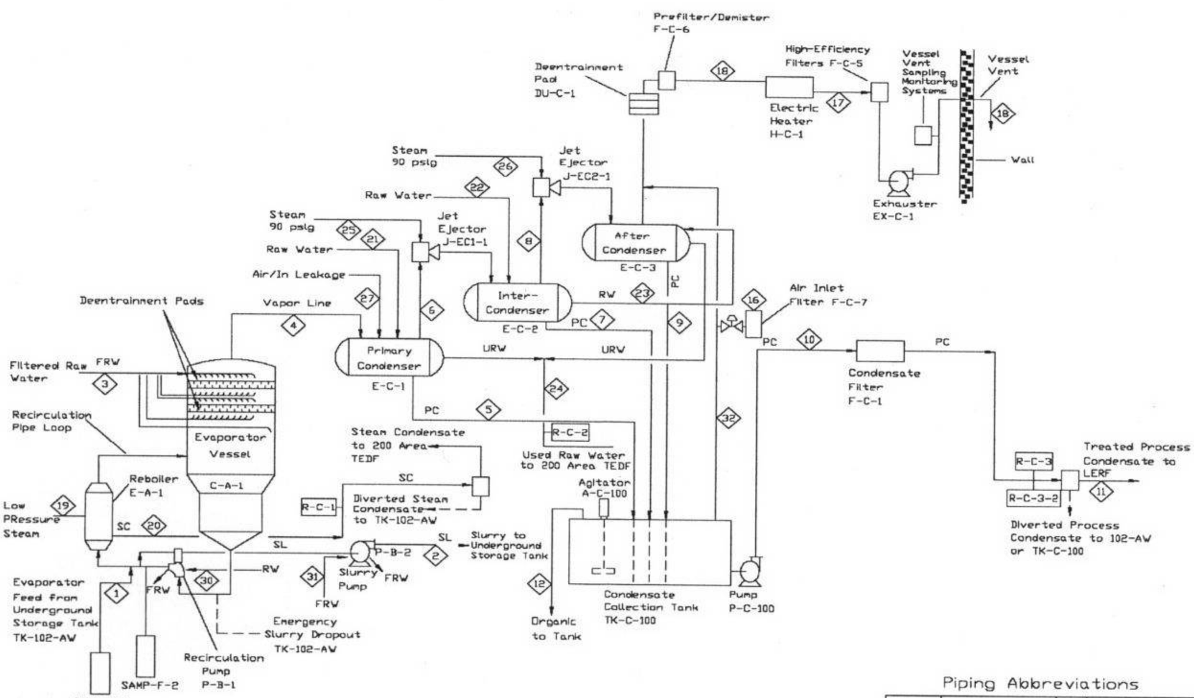
3.1.1 Process Description

The 242-A Evaporator, located in the 200 East Area of the Hanford Site, separates the incoming waste from the DST System into two aqueous streams. Also associated with the 242-A Evaporator are utility waste streams such as cooling water and steam condensate, which are not dangerous waste. A description of the waste processed by the 242-A Evaporator is provided below.

The 242-A Evaporator process uses a conventional forced-circulation, vacuum evaporation system to concentrate mixed waste solutions from the DST System tanks. The incoming stream is separated by evaporation into two liquid streams: a concentrated slurry stream and a process condensate stream. The slurry contains the majority of the radionuclide and inorganic constituents. After the slurry is concentrated to the desired level, the slurry stream is pumped back to the DST System and stored for further treatment. Vapor from the evaporation process is condensed, producing process condensate, which is primarily water with trace amounts of organic material and a greatly reduced concentration of radionuclides. The process condensate is transferred to the LERF for storage and treatment. Vacuum for the evaporator vessel is provided by two steam jet ejectors, producing a gaseous vessel vent exhaust. The 242-A Evaporator vessel vent stream is filtered and discharged through an exhaust stack. A simplified process flow diagram for the 242-A Evaporator process is provided in Figure 3.1.

The evaporator process is shutdown when the desired endpoint concentration of the slurry is met. Endpoints are established at the beginning of the campaign, based on the target specific gravity of the waste, or allowable waste volume reduction (WVR) and defined operating limits. If the evaporation rate cannot achieve the desired endpoint, slurry in the DST System serving as the slurry receiver is transferred to the feed tank for one or more passes through the 242-A Evaporator. At the end of each campaign, the 242-A Evaporator process equipment is shutdown, emptied, flushed with raw water, and placed in a safe standby mode.

Figure 3. 1 242-A Evaporator Simplified Process Flow Diagram



Piping Abbreviations

AF	Anti-Foam	PS	Process Sewer
AS	Air Sample	PW	Process Waste
DECON	Decontamination	RW	Raw Water
DR	Drain	SC	Steam Condensate
EF	Evaporator Feed	SL	Slurry
EL	Eluent	STM	Steam
FRW	Filtered Raw Water	SW	Sanitary Water
I	Instrument	U	Utility
IA	Instrument Air	URW	Used Raw Water
OVFL	Overflow	V	Vent
PA	Process Air	VAC	Vacuum
PC	Process Condensate	VV	Vessel Vent

00 Stream Number Used In Flowsheet Calculation

Process Sample

SOURCE: FIGURE 4.1 FROM PERMIT NO. WA 7890008967 (ECOLOGY, 2004)

Drawing Number: 3.1	COOPER ZIETZ ENGINEERS, INC.	242-A Evaporator Integrity Assessment Hanford Reservation 242-A Evaporator Simplified Process Flow Diagram	TechnoGeneral Services Company Engineering and Construction Management

DESIGNED BY: XX RE-CHECKED BY: XX
DRAWN BY: VCAD APPROVED BY: XX
CHECKED BY: XX DATE: 10 NOVEMBER 2008

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REVISIONS

The 242-A Evaporator process is controlled by the monitoring and control system (MCS). The MCS computer monitors process parameters and controls the parameters where required. Once the configuration parameters and other process control inputs are set, the MCS maintains the process parameters within specified ranges by sending output signals that operate specific pieces of equipment (e.g., control valves).

The 242-A Evaporator system is comprised of four subsystems as listed in Section 1.1 according to the function or process of each subsystem. Three of the subsystems associated with the 242-A Evaporator are described in more detail below. Section 3.2 provides a separate description of the PC-5000 Transfer Line subsystem as the fourth subsystem of the TSD unit.

3.1.1.1 Vapor-Liquid Separator Subsystem

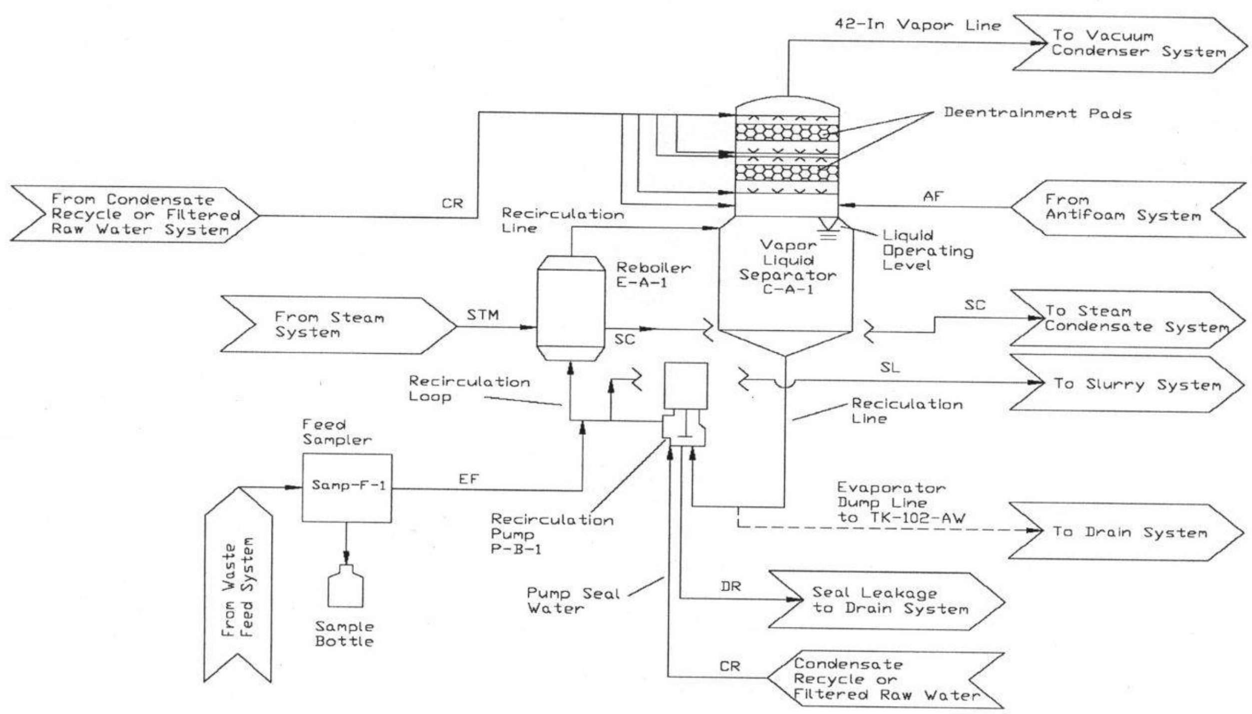
The 242-A Evaporator process employs a conventional forced circulation, vacuum evaporation system to concentrate the DST System waste solution. The major components of this system include the reboiler, vapor-liquid separator, recirculation pump, recirculation loop, and slurry system. The following subsections describe the vapor-liquid separator subsystem components. Figure 3.2 is a simplified process flow diagram showing the major components of the vapor-liquid separator subsystem.

Reboiler (E-A-1). Waste is heated as the waste passes through the reboiler before entering the vapor-liquid separator. The reboiler is a vertical tube unit with steam on the shell-side and process solution on the tube-side. The 364 tubes in the reboiler are enclosed in a 1.03-meter (3.38-feet) outside diameter, 4.6-meter (15.09-feet) long stainless steel shell. Both the reboiler shell and tubes are constructed of 304L stainless steel. The shell is 0.64 centimeter (0.25 inch) thick and the tubes are 14-gauge steel. The reboiler is designed to distribute steam evenly and to prevent tube damage from water droplets that may be present in the steam.

Vapor-Liquid Separator (C-A-1). Process solution from the reboiler enters the vapor liquid separator (VLS) via the upper recirculation line. Some of the solution flashes into vapor, which exits through a vapor line at the top of the VLS. The remaining solution (slurry) exits through the recirculation line at the bottom.

The separator consists of a lower and upper section. The lower (liquid) section is a stainless steel shell 4.3 meters (4,11 feet) in diameter having an 85,200 to 94,600 liter (22,510 to 24,993 gallons) normal operating capacity (including recirculation loop and reboiler). The maximum design capacity for storage is 103,000 liters (27,292 gallons). The upper (vapor) section is a stainless steel shell 3.5 meters (11.48 feet) in diameter containing two deentrainment pads. These wire mesh pads remove liquids and solids that entrain into the vapor section of the vessel. Spray nozzles, using recycled process condensate or filtered raw water, wash collected solids from the deentrainment pads and vessel walls. Both sections of the VLS are constructed of 0.95-centimeter (0.374-inch) thick stainless steel.

Figure 3. 2 242-A Evaporator Process Loop



Piping Abbreviations

AF	Anti-Foam	PS	Process Sewer
AS	Air Sample	PW	Process Waste
DECON	Decontamination	RW	Raw Water
DR	Drain	SC	Steam Condensate
EF	Evaporator Feed	SL	Slurry
EL	Eluent	STM	Steam
FRW	Filtered Raw Water	SW	Sanitary Water
I	Instrument	U	Utility
IA	Instrument Air	CW	Colling Water
OVFL	Overflow	V	Vent
PA	Process Air	VAC	Vacuum
PC	Process Condensate	VV	Vessel Vent
CR	Condensate Recycle		

SOURCE: FIGURE 4.2 FROM PERMIT NO. WA 7890008967 (ECOLOGY, 2004)

Drawing Number: 3.2	COOPER ZIETZ ENGINEERS, INC.	242-A Evaporator Integrity Assessment Hanford Reservation 242-A Evaporator Process Loop	TechnoGeneral Services Company Engineering and Construction Management DESIGNED BY: XX RE-CHECKED BY: XX DRAWN BY: VCAD APPROVED BY: XX CHECKED BY: XX DATE: 10 NOVEMBER 2006	REV. DATE DRWN CHKD REMARKS REVISIONS

Operating parameters in the VLS are monitored to provide an indication of process data such as slurry foaming, deentrainer flooding, or excessive vapor temperatures. Instrumentation also is available to monitor the liquid levels in the vapor-liquid separator. Interlocks are activated when high pressures or high- or low-liquid levels are detected, shutting down the evaporation process and placing the TSD unit in a safe configuration.

The VLS and recirculation loop can be flushed to remove any residual solids from the system and/or to reduce radiation levels. The most common flush solution is water, but dilute nitric or citric acid solutions can also be used. All acidic flush solutions are chemically adjusted to meet DST acceptance criteria before transfer to the DST System. Antifoam solution is added (at very low flow rates - approximately 0.04 to 0.4 liters per minute (0.011 to 0.106 gallons per minute) to the vessel to prevent foaming. The antifoam solution is a noncorrosive, nonregulated silicone-based solution that is compatible with the evaporator components.

Recirculation Pump. The stainless steel recirculation pump (P-B-1), is constructed as part of the recirculation loop to the reboiler. The 28-inch (71.12 centimeter) diameter axial flow pump has a design value of 53,000 liters per minute (14,000 gallons per minute) output with a 4.0 m (13.2 feet) total dynamic head. The recirculation pump is designed to handle slurry up to 30 percent undissolved solids by volume at specific gravities up to 1.8. The recirculation pump moves waste at high velocities through the reboiler to improve heat transfer, keep solids in suspension, and reduce fouling of the heat transfer surfaces.

The recirculation pump is equipped with shaft seals with high-pressure recycled process condensate (or water) introduced between the seals to prevent the waste solution from leaking out of the system. Seal water pressure and flow are monitored and controlled to shut down the recirculation pump if conditions are not adequate to prevent waste liquid from migrating into the seal water. The used seal water is routed to the feed tank.

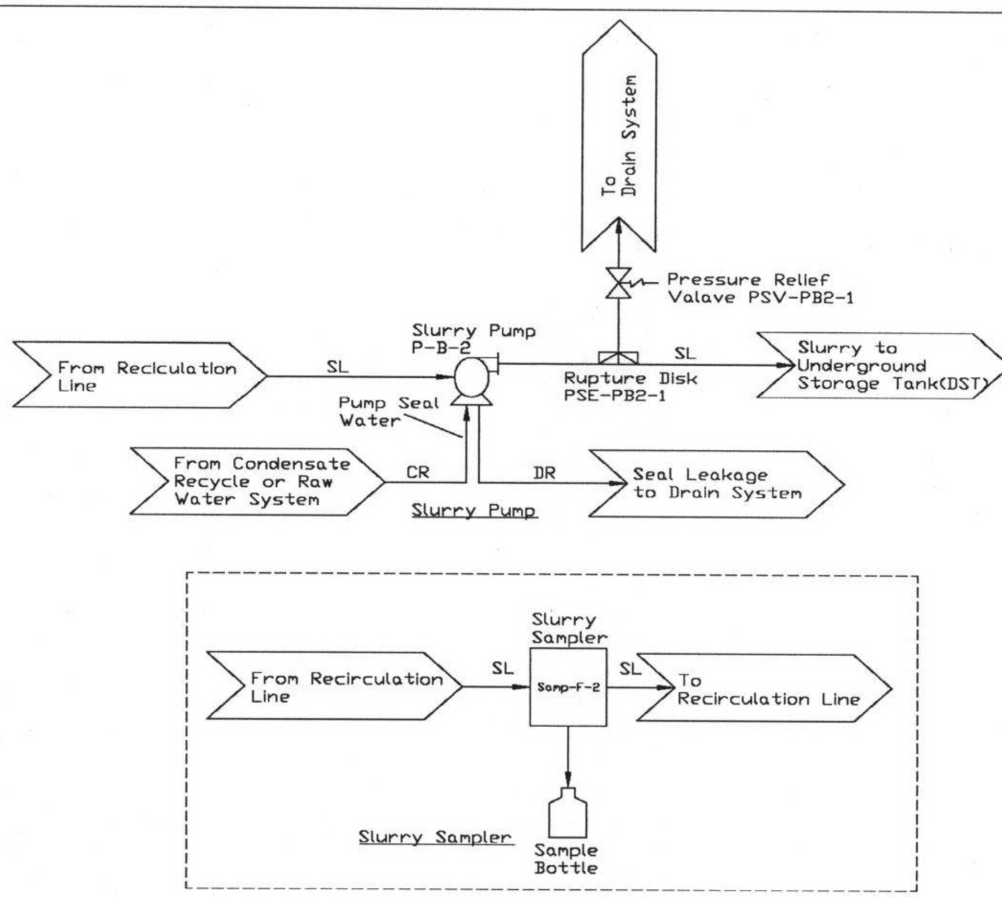
Recirculation Loop. The recirculation loop consists of a 71.12 centimeter (28 inch) diameter stainless steel pipe that connects the vapor-liquid separator to the recirculation pump and reboiler. The lower loop runs from the bottom of the vapor-liquid separator to the recirculation pump inlet. The upper loop connects the pump discharge to the reboiler and the reboiler to the vapor-liquid separator. The feed line from the feed tank and the slurry line to underground storage tanks are connected to the upper recirculation line.

Slurry System. The slurry system draws a portion of the concentrated waste from the upper recirculation loop and transfers it to the DST System. The major components of the slurry system are the slurry pump and the slurry transfer pipelines. Figure 3.3 shows a simplified flow diagram of the slurry system. These components are described in the following paragraphs.

The slurry pump (P-B-2) is used to transfer slurry from the recirculation loop to the underground storage tanks. The pump has a total dynamic head of 152m (500 feet) and is constructed of 304 L stainless steel. It is a single stage, horizontal, centrifugal pump driven by a variable speed motor with a 121 to 416 liters per minute (32 to 110 gallons per minute) normal flow. The slurry pump is designed to generate high pressures to alleviate the possibility of a transfer line plugging. Interlocks control the operation of the slurry pump. The slurry pump (P-B-2) is shutdown if any of the following occur:

- Excessive pressure is detected in the slurry lines to 241-AW Tank Farm.
- A leak is detected in the slurry transfer lines secondary containment.

Figure 3. 3 242-A Evaporator Slurry System



Piping Abbreviations

AF	Anti-Foam	PS	Process Sewer
AS	Air Sample	PW	Process Waste
DECON	Decontamination	RW	Raw Water
DR	Drain	SC	Steam Condensate
EF	Evaporator Feed	SL	Slurry
EL	Eluent	STM	Steam
FRW	Filtered Raw Water	SW	Sanitary Water
I	Instrument	U	Utility
IA	Instrument Air	CW	Colling Water
OVFL	Overflow	V	Vent
PA	Process Air	VAC	Vacuum
PC	Process Condensate	VV	Vessel Vent
CR	Condensate Recycle	DST	DOUBLE SHELL TANK

SOURCE: FIGURE 4.3 FROM PERMIT NO. WA 7890008967 (ECOLOGY, 2004)

Drawing Number: 3.3	COOPER ZIETZ ENGINEERS, INC.	242-A Evaporator Integrity Assessment Hanford Reservation	TechnoGeneral Services Company Engineering and Construction Management
		242-A Evaporator Slurry System	DESIGNED BY: XX; DRAWN BY: VCAD; CHECKED BY: XX; RE-CHECKED BY: XX; APPROVED BY: XX; DATE: 10 NOVEMBER 2006

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A leak is detected in the 241-AW Tank Farm process pits where the transfer lines enter the DST System.

The slurry pump uses a shaft seal with recycled process condensate (or water) and pressure and flow controls similar to the system described above for the recirculation pump.

Transfer pipelines are 5.08-centimeter (2-inch) diameter, carbon steel encased lines which route slurry to a designated underground DST within the 200 East Area. All transfer pipelines are encased in a secondary containment pipe and equipped with leak detectors between the primary and encasement piping. The pipelines are sloped to drain to the valve pit. The detection of any leak automatically shuts off the slurry pump.

The flow rate of the slurry transfer to the DST System is monitored and a decrease in flow below a specified value automatically will shut down the slurry pump (P-B-2) and initiate a line flush with water. The objective of flushing the transfer line is to prevent settling of solids, which precludes plugging the slurry transfer lines.

Samples can be taken from the slurry line when needed via a sampler (SAMP-F-2) that is located near the feed sampler in the load-out and hot equipment storage room.

3.1.1.2 Condensate Collection Subsystem

The following section discusses the condensate collection tank subsystem. This equipment collects process condensate via the condensers in the vacuum condenser system, filters the condensate, and pumps the process condensate to LERF. Figure 3.4 provides a simplified process flow diagram showing the major components of the process condensate collection subsystem. The following major components make up the process condensate collection subsystem:

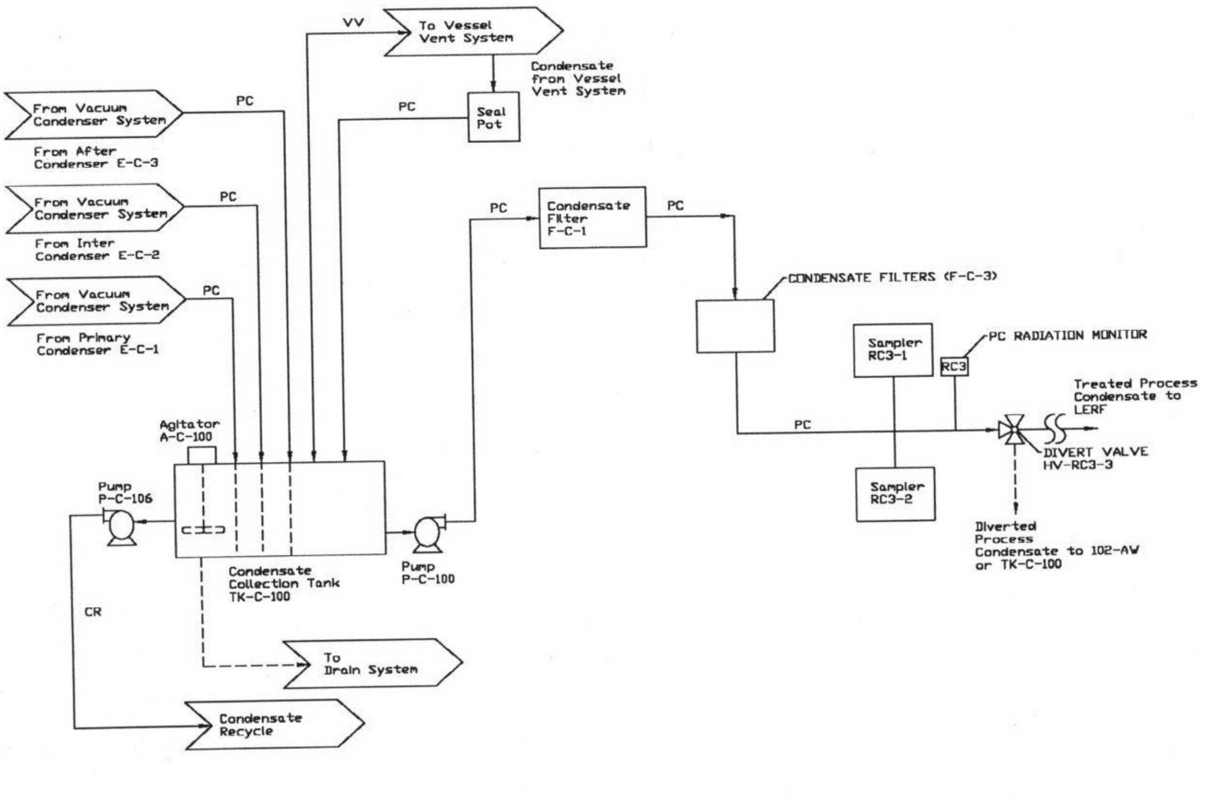
- Vacuum condenser system
- Condensate collection tank (TK-C-100)
- Process condensate pump (P-C100)
- Condensate filters (F-C-1 and F-C-3)
- Process condensate radiation monitoring, sampling system and diversion system (RC3)
- Seal pot
- Process condensate recycle system.

3.1.1.2.1 Vacuum Condenser System

Vapors removed from the vapor-liquid separator flow to a series of three condensers where the vapors are condensed using raw water. Condensate drains to the condensate collection tank (TK-C-100). The vacuum condenser system consists of the following major components:

- Primary condenser (E-C-1)
- Intercondenser (E-C-2)
- Aftercondenser (E-C-3)
- Steam jet ejectors (J-EC1-1 and J-EC2-1)

Figure 3. 4 242-A Evaporator Condensate Collection System



Piping Abbreviations

AF	Anti-Foam	PS	Process Sewer
AS	Air Sample	PW	Process Waste
DECON	Decontamination	RW	Raw Water
DR	Drain	SC	Steam Condensate
EF	Evaporator Feed	SL	Slurry
EL	Eluent	STM	Steam
FRW	Filtered Raw Water	SW	Sanitary Water
I	Instrument	U	Utility
IA	Instrument Air	CW	Coiling Water
OVFL	Overflow	V	Vent
PA	Process Air	VAC	Vacuum
PC	Process Condensate	VV	Vessel Vent
CR	Condensate Recycle		

LERF=Liquid Effluent Retention Facility

SOURCE: FIGURE 4.4 FROM PERMIT NO. WA 7890008967
(ECOLOGY, 2004)

Drawing Number: 3.4

COOPER ZIETZ ENGINEERS, INC.

242-A Evaporator
Integrity Assessment
Hanford Reservation

242-A Evaporator
Condensate Collection System

TGS *TechnoGeneral Services Company*
Engineering and Construction Management

DESIGNED BY: XX
DRAWN BY: VCAD
CHECKED BY: XX
RE-CHECKED BY: XX
APPROVED BY: XX
DATE: 10 NOVEMBER 2006

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Figure 3.5 provides a simplified process flow diagram showing the major components of the vacuum condenser system. These system components are discussed in the following sections.

Primary Condenser (E-C-1). Vapors drawn from the vapor-liquid separator flow through the 1.07 meter (3.5 feet) vapor line, into the E-C-1 condenser where the majority of the condensation takes place. Noncondensed vapors exit to the intercondenser (E-C-2) while the condensed vapors (process condensate) drain to the condensate collection tank (TK-C-100). Cooling water passes through the cooling tubes and exits to Treated Effluent Disposal Facility (TEDF).

The carbon steel condenser shell measures approximately 5.3 meters (17.4 feet) long and has a 2.2-meter (7.2 feet) inside diameter. The condenser consists of 2,950 equally spaced carbon steel tubes that are 3.6 meters (11.8 feet) long with a 1.9-centimeter (0.75 inches) outside diameter.

Intercondenser (E-C-2). Noncondensed vapors from E-C-1 enter the intercondenser. The vapor stream contacts the cooling tubes in the condenser where cooling water provides additional condensation. The condensate drains to the condensate collection tank (TK-C-100). Noncondensed vapors and used cooling water are routed to the aftercondenser.

The carbon steel intercondenser measures 2.2 meters (7.2 feet) long with a 0.39 meter (1.3 feet) inside diameter. This heat exchanger contains 144 tubes that are 1.7 meters (5.6 feet) long with a 1.9-centimeter (0.75 inches) outside diameter.

Aftercondenser (E-C-3). Vapor discharged from the intercondenser enters the aftercondenser. Cooling is supplied to the aftercondenser by the cooling water from the intercondenser. Condensate is routed to the condensate collection tank (TK-C-100), while the noncondensed vapors are filtered, monitored, and discharged to the atmosphere through the vessel ventilation system. The cooling water is discharged to TEDF.

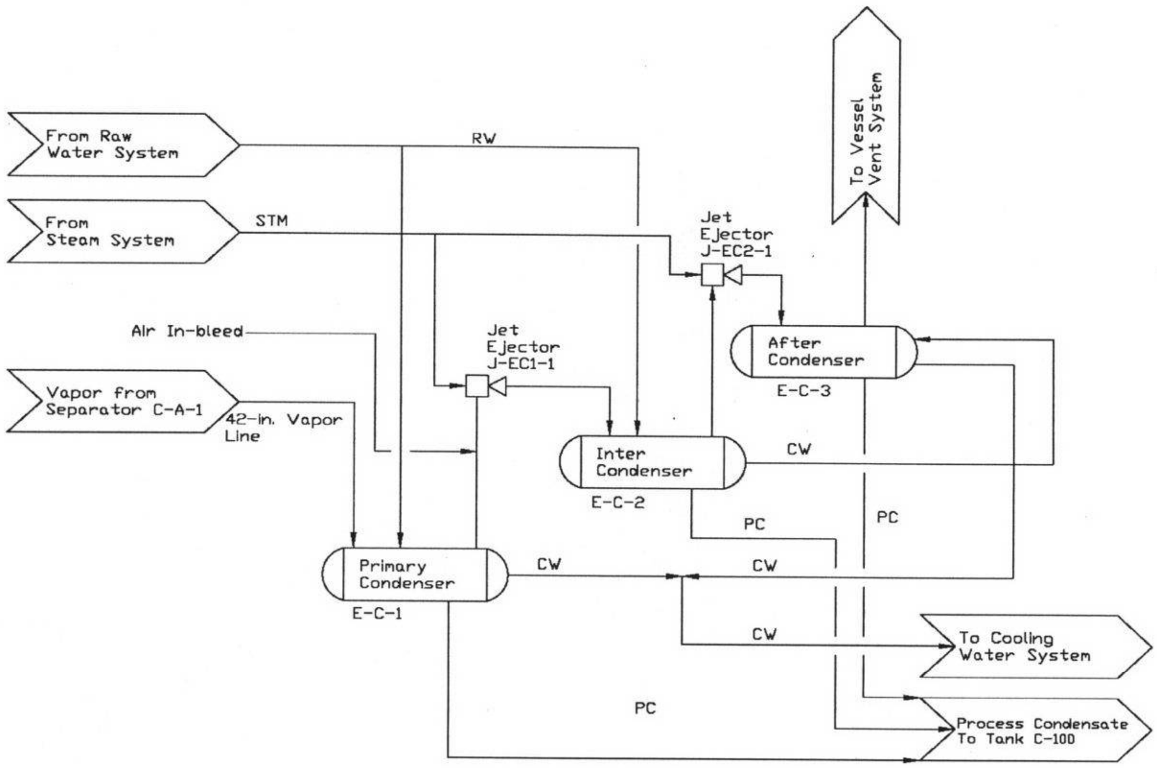
The carbon steel aftercondenser measures 2.3 meters (7.5 feet) long and has a 0.20-meter (0.66 feet) inside diameter. This heat exchanger contains 45 tubes that are 1.8 meters (5.9 feet) long with a 1.9-centimeter (0.75 inches) outside diameter.

Steam Jet Ejectors. The vacuum that draws the vapors from C-A-1 into the condensers is created by a two-stage steam jet ejector system. The first-stage jet ejector (J-EC1-1) maintains a vacuum on the primary condenser, which in turn creates a vacuum on the vapor-liquid separator. The ejector consists of a steam jet, pressure controller, and air bleed-in valve. Steam and noncondensed vapors from the primary condenser are ejected from J-EC1-1 into the intercondenser. The desired vacuum is obtained by controlling steam pressure and bleeding ambient air as necessary into the vapor header through an air intake filter. The second-stage jet ejector (J-EC2-1) creates the vacuum that moves vapors from the intercondenser through the aftercondenser.

3.1.1.2.2 Condensate Collection Tank (TK-C-100)

Process condensate from the primary condenser, intercondenser, aftercondenser, and the vessel ventilation system drain to the condensate collection tank (TK-C-100). The tank is 4.3 meters (14.1 feet) in diameter, 5.8 meters (19 feet) high, and is constructed of 0.79-centimeter (0.31 inches)-thick stainless steel.

Figure 3. 5 242-A Evaporator Vacuum Condenser System



Piping Abbreviations

AF	Anti-Foam	PS	Process Sewer
AS	Air Sample	PW	Process Waste
DECON	Decontamination	RW	Raw Water
DR	Drain	SC	Steam Condensate
EF	Evaporator Feed	SL	Slurry
EL	Eluent	STM	Steam
FRW	Filtered Raw Water	SW	Sanitary Water
I	Instrument	U	Utility
IA	Instrument Air	CW	Colling Water
OVFL	Overflow	V	Vent
PA	Process Air	VAC	Vacuum
PC	Process Condensate	VV	Vessel Vent
CR	Condensate Recycle		

SOURCE: FIGURE 4.5 FROM PERMIT NO. WA 7890008967 (ECOLOGY, 2004)

Drawing Number: 3.5	COOPER ZIETZ ENGINEERS, INC.	242-A Evaporator Integrity Assessment Hanford Reservation 242-A Evaporator Vacuum Condenser System	TechnoGeneral Services Company Engineering and Construction Management DESIGNED BY: XX DRAWN BY: VCAD CHECKED BY: XX	RE-CHECKED BY: XX APPROVED BY: XX DATE: 10 NOVEMBER 2006

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The tank has a maximum design capacity of 67,400 liters (17,805 gallons). Normal operating volume is approximately 50 percent of the tank capacity. A carbon steel base supports the tank. An agitator is installed but not used.

In the event of a tank overflow, the solution is routed through an overflow line to the drain system, which returns waste to the feed tank (241-AW-102). Overflow occurs when the volume exceeds about 60,600 liters (16,009 gallons). The overflow line is equipped with a liquid filled trap to isolate the drain system from the tank.

Process feed samples are evaluated for the presence of a separate organic layer and process controls are used to reduce the risk of the condensate collection tank to receive small amounts of immiscible organics with the condensed waste. If detected, the organic layer is removed by overflowing tank TK-C-100 back to the feed tank 241-AW-102. The liquid level in the tank is controlled well above the discharge pump intake point and a controlled overflow is conducted upon completion of each processing cycle (campaign) to ensure that an organic layer does not accumulate and cannot be pumped to LERF.

3.1.1.2.3 Process Condensate Pump. A pump (P-C100) moves the process condensate from tank TK-C-100 through the condensate filter to LERF. The process condensate pump is a centrifugal pump constructed of 316 stainless steel.

3.1.1.2.4 Condensate Filters. After leaving the condensate collection tank, the process condensate is filtered to remove solids. The primary condensate filter (F-C-1) has a welded steel housing. A second filter system (F-C-3), installed downstream is also used to filter the process condensate that is routed to sampler SAMP-RC3-1. This system has a cast iron housing. Both filters employ a filter material that is compatible with the process condensate.

3.1.1.2.5 Process Condensate Radiation Monitoring, Sampling and Diversion System. The process condensate transferred to LERF is monitored continuously for radiation. If radiation levels exceed established limits, an alarm is received and interlocks immediately divert the stream back to the condensate collection tank (or the feed tank) and shut off the process condensate pump. This ensures process condensate containing excessive radionuclides due to an accidental carryover from the vapor-liquid separator is not transferred to LERF.

3.1.1.2.6 Seal Pot. The condensate collection tank receives condensed liquids from the vessel ventilation system. A seal pot collects the drainage before discharge into the condensate collection tank and isolates the tank from the vessel ventilation system. The seal pot discharge is a hazardous waste.

3.1.1.2.7 Process Condensate Recycle System

For waste minimization, a portion of the process condensate from tank TK-C-100 is recycled for use as decontamination solution for the deentrainment pad sprays and seal water for the recirculation pump (P-B-1) and slurry pump (P-B-2). Use of process condensate instead of raw water results in approximately 10 percent reduction in waste volume generated during continuous operation of the 242 - A Evaporator. Filtered raw water also is available as a backup for sprays and seal water. A 2 - inch (5.1 centimeters) diameter carbon steel line, stainless steel centrifugal pump (P-C106), and filters (F-C-5 and F-C-6) supply process condensate from tank TK-C-100 to the pad sprays and pump seals. The filters are disposable cartridge filters in carbon steel housings arranged in parallel with one filter in service while the other is in standby.

3.1.1.3 Building and Secondary Containment Subsystem

This section describes the 242-A Building secondary containment and transfer line containment for the 242-A Evaporator.

3.1.1.3.1 242-A Building Secondary Containment

The 242-A Building serves as a secondary containment vault for the vapor-liquid separator (C-A-1), condensate collection tank (TK-C-100), and ancillary equipment used for transferring mixed waste at the 242-A Evaporator. The concrete for the operating area was poured to form a monolithic structure. Where needed, joints in the concrete were fabricated with preformed filler conforming to the standards of the American Society of Testing and Materials. Joint filler is sealed with a polysulfide sealant per the requirements of the construction specifications (Vitro 1974).

Before restart in 1994, a new acrylic special protective coating was applied to the concrete in the pump, evaporator, and condenser rooms. The coating meets the requirements of the construction specifications (Vitro 1974), including resistance to very high radiations doses, temperatures of 77°C (171°F), and spills of 25 percent caustic solution.

The following six rooms contain equipment used to process or store mixed waste:

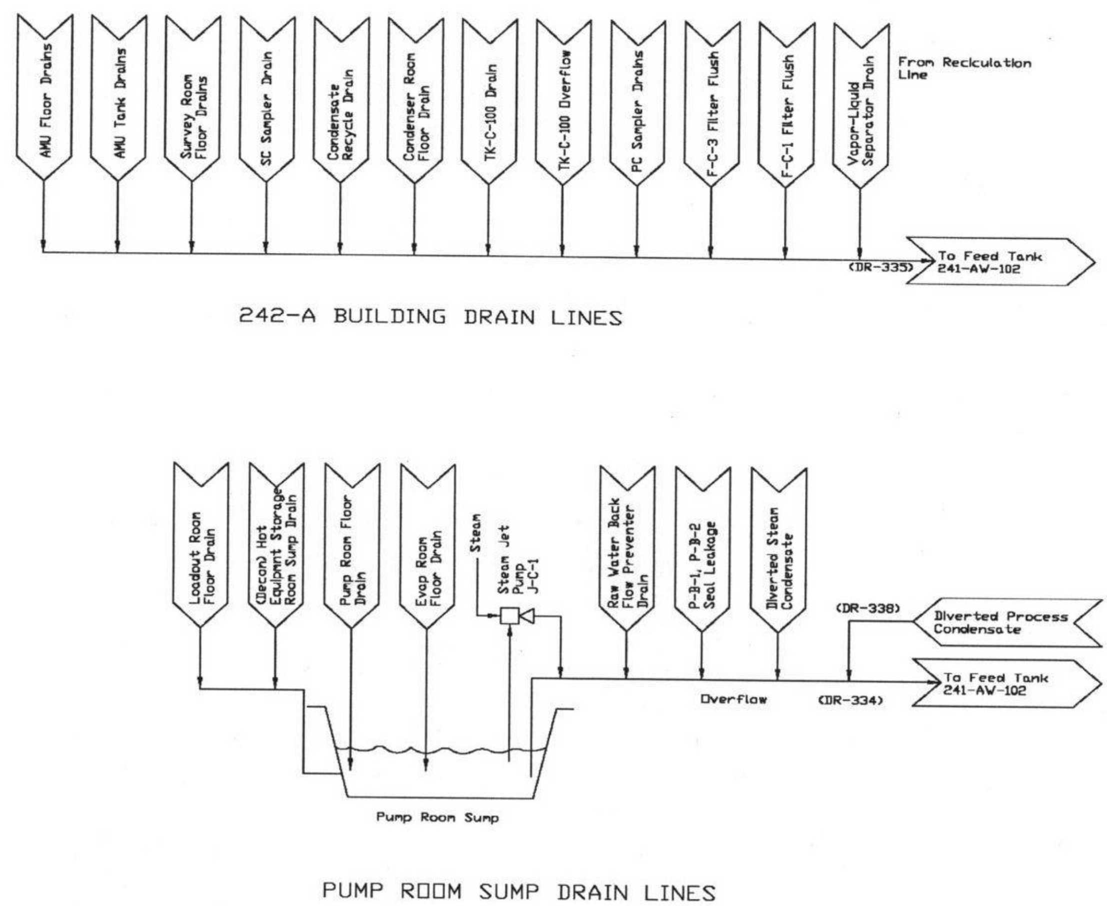
- Pump room
- Evaporator room
- Condenser room
- Load out room (used for temporary storage of mixed waste)
- Hot equipment storage room.

Pump Room. The pump room secondary containment walls are 0.38 to 0.56-meter (1.25 to 1.84-feet) thick reinforced concrete. The secondary containment floor is 0.51-meter (1.67-feet) thick reinforced concrete. The pump room floor is lined with 0.64-centimeter (0.25-inch) stainless steel and the concrete walls and ceiling cover blocks are painted with a special protective coating. The pump room contains pipe jumpers used to transport feed and slurry solutions between the vapor-liquid separator and the DST System, and the process recirculation loop, recirculation pump (P-B-1), and slurry pump (P-B-2).

Leaks in the pump room collect in the pump room sump, a 1.5-meter (4.9-feet) by 1.5-meter (4.9-feet) by 1.8-meter (5.9 feet) deep sump with a 0.64-centimeter (0.25-inch) stainless steel liner. The pump room sump collects spills from various sources for transfer to the feed tank, 241-AW-102. Figure 3.6 provides a simplified process flow schematic of sources, which drain to the pump room sump. Drainage to the sump includes:

- Loadout room floor drain
- Hot equipment storage room floor drain
- Leaks to the pump room floor from equipment in the pump room
- Evaporator room floor drain
- Raw water backflow preventer drain.

Figure 3. 6 242-A Evaporator Drain System



SOURCE: FIGURE 4.6 FROM PERMIT NO. WA 7890008967 (ECOLOGY, 2004)

Drawing Number: 3.6	COOPER ZIETZ ENGINEERS, INC.	242-A Evaporator Integrity Assessment Hanford Reservation 242-A Evaporator Drain System	TechnoGeneral Services Company Engineering and Construction Management DESIGNED BY: XX DRAWN BY: VCAD CHECKED BY: XX	RE-CHECKED BY: XX APPROVED BY: XX DATE: 10 NOVEMBER 2008

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Solution in the pump room sump is transferred to the feed tank (241-AW-102) using a steam jet. A 25.4-centimeter (10-inch) secondary containment overflow line is provided for draining large volumes of solution should a catastrophic tank failure occur. Because the overflow line provides a direct path between the air space of tank 241-AW-102 and the pump room, a minimum level of water must be maintained in the sump to prevent cross ventilation. A leak into the pump room sump would be detected by a rise in the sump level. Instrumentation provides alarms on high sump level.

The recirculation and slurry pumps in the pump room are equipped with mechanical seals having pressurized water introduced between the seals. The seal water is maintained at a pressure that exceeds the process pressure at the seal to ensure water leaks into the process solution, but waste solution does not leak out. Water from seal leakage is collected in funnels in the pump room and routed to feed tank 241-AW-102 via the 10-inch (25.4-centimeter) overflow line described previously.

Evaporator Room. The evaporator room secondary containment walls are 0.56 meter (1.84-feet) thick reinforced concrete. The secondary containment floor is 0.51 meter (1.67 feet) thick reinforced concrete. The evaporator room contains the vapor-liquid separator vessel (C-A-1), part of the recirculation loop, the reboiler, the 1.07 meter (3.5 feet) vapor line, and line used to empty the vapor-liquid separator to feed tank 241-AW-102.

Leaks in the evaporator room flow to a floor drain that routes through a 3-inch (7.62- centimeter) line to the pump room sump. A leak in the evaporator room would be detected by a rise in the pump room sump level. The floor of the evaporator room and a portion of the pump room floor are 3.0 meters (9.84 feet) below grade to contain the entire contents of the vapor-liquid separator, reboiler, and recirculation loop in the event of a catastrophic failure. The floor and walls of the evaporator room up to an elevation of 1.8 meters (5.9 feet) are painted with a special protective coating.

Condenser Room. The condenser room secondary containment walls are 0.36- to 0.56-meter (1.18 to 1.84-feet) thick reinforced concrete. The secondary containment floor is 0.51 meter (1.67 feet) thick reinforced concrete. The condenser room contains all the components of the process condensate system described in Section 3.1.2.2 (refer Figure 3.3), including tank TK-C-100.

Leaks in the condenser room flow to two floor drains that join and route through a 6-inch (15.24-centimeter) line to feed tank 241-AW-102. Leaks in the condenser room are detected by the following:

- Unexpected changes in liquid level in tank TK-C-100. Instrumentation is provided to monitor liquid level in the tank, including high- and low-level alarms.
- Daily visual inspections of process condensate system components and piping.

The floor and walls of the condenser room up to an elevation of 1.2 meters (3.94 feet) are painted with a special protective coating.

Load out and Hot Equipment Storage Rooms. The load out and hot equipment storage rooms secondary containment walls are 0.30- to 0.56-meter (0.98- to 1.84-feet) thick reinforced concrete. The secondary containment floors are 0.15-meter (0.49-feet) thick reinforced concrete. The room contains two recirculation lines and samplers used to sample the feed and slurry streams. The lines and samplers are located in a shielded enclosure adjacent to the pump room wall.

The load out and hot equipment storage room contains two sumps: the drain sump and decontamination sump. The sumps are 0.91 meter (2.99 feet) in diameter, about 1.2 meters (3.94 feet) deep, and lined with stainless steel. Both sumps drain via a 7.62 centimeter (3-inch) drain line to the pump room sump. The sumps, floor, and walls of the load out and hot equipment storage room up to an elevation of 3.8 meters (12.47 feet) are painted with a special protective coating.

Leaks in the sampler piping, flow into two drains in the sample enclosure, which drain via a 5.1 centimeter (2 inch) line to the decontamination sump, which drains to the pump room sump. Leaks in the sampler piping are detected by leak detectors in the sampler enclosures or a rise in the pump room sump level.

242-A Building Drain Lines. Figure 3.6 provides a simplified process flow schematic of sources routed to the 242-A Building drain lines. The 242-A Evaporator System RCRA Permit unit boundary includes these lines up until they exit the 242-A Building. At this point, the lines are considered DST system components. Four lines serve to drain the 242-A Building and equipment to feed tank 241-AW-102:

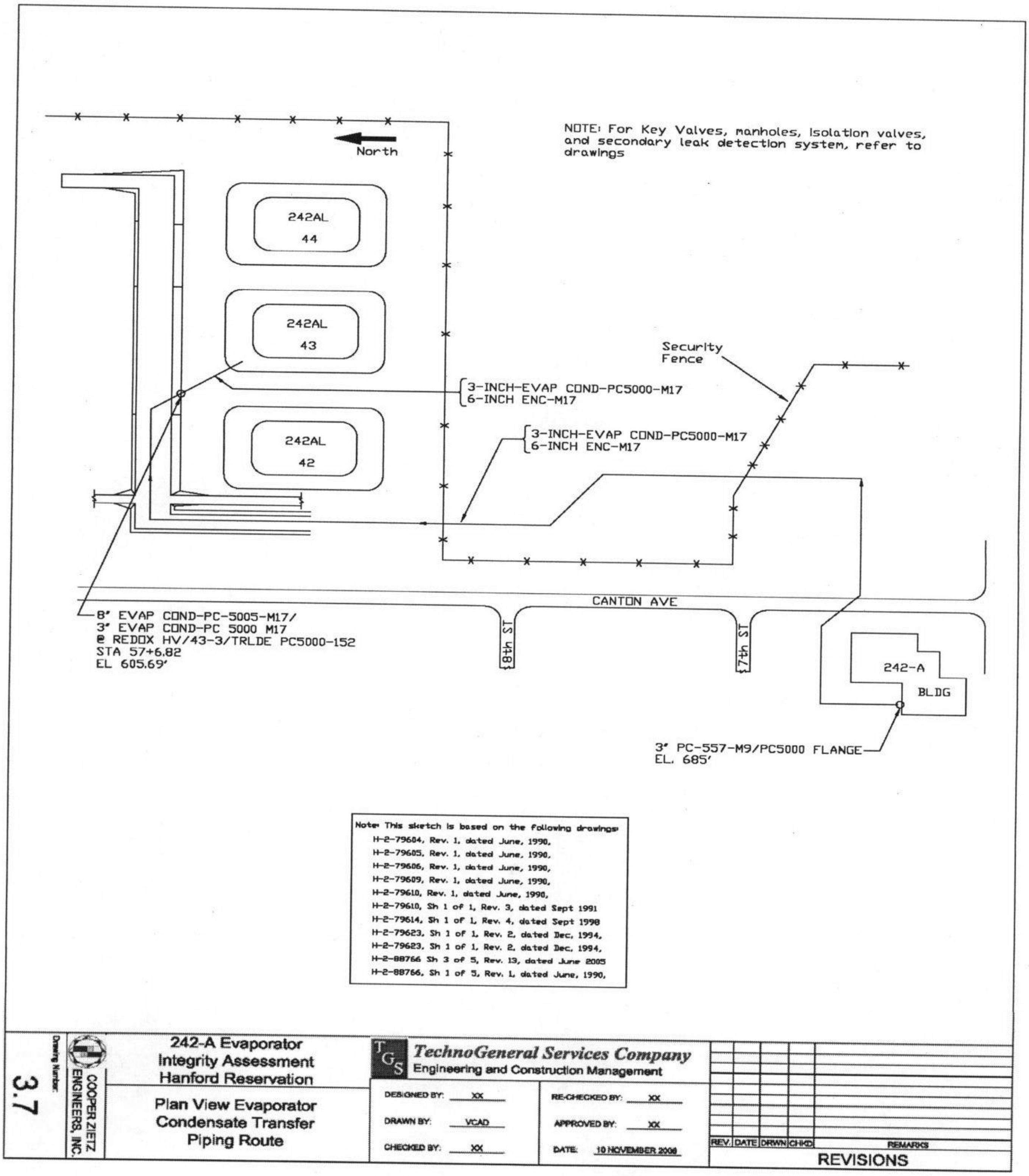
- Pump room sump drain line (DR-334): a 25.4 centimeter (10-inch) carbon steel line that transfers process condensate overflow/diverted liquids and empty-out of the pump room sump to the feed tank
- Vapor-liquid separator vessel drain line (DR-335): a 25.4 centimeter (10 inch) carbon steel line that allows gravity drain of the vessel to the feed tank
- Condenser room drain line (DR-343): a 15.24 centimeter (6-inch) carbon steel line that drains potential leakage from the condenser room
- Diverted process condensate drain line (DR-338): process condensate liquid drains through DR-338 into sump drain line (DR-334) which drains to 241-AW-102

The four lines are sloped to drain about 170 meters (558 feet) to feed tank 241-AW-102 via the drain pit (241-AW-02D). Although WAC 173-303-640(1)(c) exempts systems that serve as secondary containment from requiring secondary containment, drain lines DR-334, DR-335, and DR-338 have outer encasement piping.

The drain lines are connected to a cathodic protection system to prevent external corrosion from contact with the soil. The cathodic protection system consists of:

- A rectifier that converts supplied alternating current voltage to an adjustable direct current voltage
- Numerous anodes buried near the underground piping and connected to the rectifier.
- Return wiring that connects the piping to the rectifier, completing the circuit.

Figure 3. 7 Plan View Evaporator Condensate Transfer Piping Route



The rectifiers are inspected to assure component degradation has not occurred. Test stations along the system are checked annually to verify 0.85 volt is maintained on the system, as required by the National Association of Corrosion Engineers.

Further detail regarding design and construction of DR-334,-335,-338 and -343 is provided in DOE/RL-90-39 (U.S. DOE 2005). Further detail regarding the design, operation, maintenance, and inspection of the cathodic protect system for these lines are also provided in DOE/RL-90-39.

3.1.1.3.2 Transfer Line Containment

This section describes the secondary containment and leak detection systems for transfer lines between the DST System and the 242-A Evaporator. The 242-A TSD boundary for lines running between 242A and the DST System ends at exterior wall of 242-A building. At this point, these lines (e.g., feed line piping [SN-269 and SN-270] and slurry line piping [SL-167and SL-168] are DST System components. The lines SN-269 and SL-168 are not currently in use (i.e., not physically connected to the 242-A Evaporator TSD unit) and may not be available for use due to RCRA compliance status. For further details regarding SN-269 and SL-167, refer to DOE/RL-90-39 (U.S.DOE 2005).

Feed Line Piping. The feed line (SN-269) consists of 7.62 centimeter (3 inch) transfer piping within a 6-inch (15.24 centimeter) secondary containment encasement piping. Both the transfer and encasement pipes are constructed of Schedule 40 carbon steel. The lines run below grade about 120 meters (394 feet) from pump pit 241-AW-02E (above feed tank 241-AW-102) to the 242-A Building.

To detect transfer-piping failures, leak detector risers equipped with conductivity probes are installed on the encasement lines. The transfer piping and encasements are sloped towards the conductivity probe, which, on leak detection, annunciates an alarm in the 242-A Evaporator control room. A valve in the pump pit (241-AW-02E) can be opened to drain solution from the encasement pipe into the pit, which drains to feed tank 241-AW-102.

Slurry Line Piping. The slurry pump (P-B-2) transfers solution through the transfer line (SL-167) for transfer to valve pit 241-AW-B (standard configuration). Slurry solution can be routed via double-encased piping from these valve pits to any designated DST slurry receiver. Both slurry transfer lines consist of 5.1-centimeter (2 inch) transfer piping within a 10.2-centimeter (4-inch) secondary containment encasement piping. Both the transfer and encasement pipes are constructed of Schedule 40 carbon steel. The lines run below grade about 73 meters (240 feet) between the 242-A Building and the valve pits.

These slurry lines contain leak detector risers and conductivity probes similar to the feed line piping.

3.1.2 Waste Characteristics

The waste processed at the 242-A Evaporator is classified as a mixed waste because it contains radioactive components and is a dangerous waste. The concentrated slurry produced by the evaporation process is also a mixed waste because it contains the same mixed waste constituents as the waste feed.

Analysis of utility streams which do not contact mixed waste solutions, such as cooling water and steam condensate, are conducted per the requirements of the 200 Area

TEDF, which receives these streams. These analyses are not discussed in this plan because these streams are not dangerous waste under WAC 173-303.

The only waste stream processed at the 242-A Evaporator is the DST System waste stream, which consists of mixed waste received from various Hanford Site activities. The mixed waste is a radioactive aqueous solution containing dissolved inorganic salts such as sodium, potassium, aluminum, hydroxides, nitrates, and nitrites. The mixed waste in some tanks has detectable levels of heavy metals such as lead, chromium, and cadmium. The radionuclide content includes fission products such as the Sr-90 and Cs-137, and actinide series elements such as uranium and plutonium. Small quantities of ammonia and organics, such as acetone, butanol, and tri-butyl phosphate, could also be present. Waste received in the DST System has been chemically adjusted to ensure the waste is compatible with materials used for construction of the waste tanks and the 242-A Evaporator. The consistency of the waste in the DST System ranges from liquid supernate to thick sludge. Waste fed to the 242-A Evaporator is supernate taken from the DST System in accordance with the Permit WA 7890008967, Chapter 3, Waste Analysis Plan; the sludge is not processed through the 242-A Evaporator.

The slurry is an aqueous solution containing the same components as the feed stream with increased concentrations. Most of the volatile constituents are evaporated and transferred to the process condensate. The waste characteristics of the process condensate generated at the 242-A Evaporator TSD unit is presented in Section 3.2.1.

Tables 3.1 and 3.2 present the chemical composition of evaporator feed and concentrated slurry (LMHC, 1998b). Table 3.3 presents 242-Evaporator Bulk Chemistry Solutions (LMHC, 1998b).

The next evaporator campaign is scheduled for 2007. Waste feed is analyzed prior to the campaign in accordance with waste analysis plan (WAP) and RCRA requirements. The slurry is sampled during the campaign for process control purposes. During this campaign, the next RCRA sampling of the waste feed and concentrated slurry at the 242-A Evaporator will be performed to confirm the characterization is correct. Sampling and analysis of waste feed and slurry at the 242-A Evaporator is included in the TSD unit Permit WA 7890008967, Part III Operating Unit 4, Chapter 3, Waste Analysis Plan (Ecology 2004b).

3.1.3 Operating Parameters

Operating parameters for the 242-A Evaporator include the flow rate, pressure, and temperature ranges and limits for the system. These parameters are listed in Table 3.4 from 1998 IAR (LMHC, 1998b). Each evaporator campaign has different operating conditions and the conditions during past campaigns may not be representative of future campaigns due to changing contents of the double shell tanks. Data will be gathered during the examination of the system acquiring past reports called "Process Control Plans and Post Run documents" as well as future plans to provide the current information on the operating parameters of the 242-A Evaporator TSD unit.

Operating parameters in the vapor-liquid separator are monitored to provide an indication of process problems such as slurry foaming, deentrainer flooding, or excessive vapor temperatures. Instrumentation also is available to monitor the liquid levels in the vapor-liquid separator. Interlocks are activated when high pressures or high- or low-liquid levels are detected, shutting down the evaporation process and placing the TSD unit in a safe configuration.

3.2 PC-5000 Transfer Line Subsystem

The following subsections provide the process description, system description, secondary containment, waste characteristics, and operating parameters associated with the PC-5000 transfer line subsystem.

3.2.1 Process Description

The PC-5000 Process Condensate Transfer Line receives the condensed water vapors (process condensate) from the condensate collection tank (TK-C-100). The process condensate drains into the condensate collection tank and is transferred to the LERF. The process condensate transferred to LERF is monitored continuously for flow, solids, and radiation per HNF 3395 (ICP) and HNF 3172 (WAR). In addition to radiation monitoring, the process condensate is monitored for separable organic layer in condensate collection tank (TK-C-100), and is manually sampled and analyzed to confirm RCRA permit requirements are met as per Permit WA 7890008967, Part III Operating Unit 4, Chapter 3, Waste Analysis Plan (Ecology 2004a). If radiation levels exceed established limits, an alarm is received and interlocks immediately divert the stream back to the condensate collection tank (or the feed tank) and shut off the process condensate pump. This ensures process condensate containing excessive radionuclides due to an accidental carryover from the vapor-liquid separator is not transferred to LERF.

3.2.2 System Description

The process condensate transfer line (PC-5000) from the 242-A Evaporator is centrifugally cast, fiberglass-reinforced epoxy thermoset resin pressure pipe fabricated to meet the requirements of ASME D2997 (ASME 1989). The 7.6-centimeter (3-inch) carrier piping is centered and supported within 15.2-centimeter (6 -inch) containment piping. Pipe supports are fabricated of the same material as the pipe, and meet the strength requirements of ANSI B31.3 (ANSI 1987) for dead weight and seismic loads. Drawing H-2-79604 provides details of the piping from the 242-A Evaporator to LERF (Attachment A).

This IAP includes the portion of the PC-5000 line leaving the 242-A Evaporator TSD unit to the fence line of LERF. Figure 3.7 shows the plan view of the PC-5000 Transfer Line (WHC, 1993c).

An integrity assessment for PC-5000 was performed, including a hydrostatic leak/pressure test at 10.5 kilograms per square centimeter gauge (150 pounds per square inch). A statement by an Independent, Qualified, Registered Professional Engineer attesting to the integrity of the piping system is included in *Integrity Assessment Report for the 242-A Evaporator/LERF Waste Transfer Piping, Project W105* (WHC 1993c), along with the results of the leak/pressure test.

3.2.3 Secondary Containment and Release Detection for PC-5000 Transfer Line

This section describes the secondary containment and leak detection systems for PC-5000 transfer line from 242-A Evaporator to LERF. The 242-A TSD unit boundary includes PC-5000 up to the LERF fence line.

The PC-5000 transfer line piping system is a double-containment system. An inner pipe (primary containment) is 3-inch (7.6-centimeter) diameter and carries the 242-A Evaporator process condensate stream and the 6-inch (15.2-centimeter) diameter outer pipe provides secondary containment in the event there is a failure of the inner pipe.

Single-point electronic leak detection elements are installed along the transfer line at 305 meter (1000 feet) intervals. The leak detection elements are located in the bottom of specially designed test risers. Each sensor element employs a conductivity sensor, which is connected to a cable leading back to the 242-A Evaporator control room. If a leak develops in the carrier pipe, fluid will travel down the exterior surface of the carrier pipe or the interior of the containment pipe. As moisture contacts a sensor unit, the alarm sounds in the 242-A Evaporator and/or the ETF control room and the zone of the leak is indicated on the digital display. The pump located in the 242-A Evaporator is shut down, stopping the flow of aqueous waste through the transfer line. A low-volume air purge of the annulus between the carrier pipe and the containment pipe is provided to prevent condensation buildup and minimize false alarms by the leak detection elements.

Prior to each campaign attempts are made to operate the PC-5000 line automated leak detection system. Although continued attempts to maintain the automated system are made, the system has a history of false alarms. Alternative leak detection (visual inspection at the LERF end of the line) has been utilized since 2003.

3.2.4 Waste Characteristics

The 242-A Evaporator process condensate contains the volatile constituents of the waste and trace quantities of inorganic materials and radionuclides. Table 3.6 presents the waste (effluent) characteristics of the process condensate (WHC 1993c). The waste stream is classified as a Washington State Dangerous Waste (Ecology 2004a).

The next evaporator campaign is scheduled for 2007. During this campaign, the next RCRA sampling of process condensate at the 242-A Evaporator will be performed to confirm the characterization is correct. RCRA sampling of process condensate transferred to the LERF can be performed either at the 242-A Evaporator or at LERF. A discussion of process condensate sampling at the 242-A Evaporator is included in the TSD unit Permit WA 7890008967, Chapter 3, Waste Analysis Plan (Ecology 2004a), while discussion of process condensate sampling at LERF is included in the LERF RCRA Permit WA 7890008967, Part III, Liquid Effluent Retention Facility and 200 Area Effluent Treatment Facility (Ecology 2004b).

3.2.5 Operating Parameters

Operating parameters for the PC-5000 Process Condensate Transfer Line include the flow rate, pressure, and temperature ranges and limits for the system. The inner pipe (primary containment) is designed for 100 pounds per square inch (psi) (7 kilogram per square centimeter) operating pressure; the outer pipe (secondary containment) is designed for 60 psi (4.2 kilogram per square centimeter) operating pressure. The maximum operating temperature is 120° F.

The pipeline system is designed to ensure that no pressure surges or "water hammer" will take place during the operation of the pipeline.

Table 3. 1 Chemical Composition of Evaporator Feed

COMPOUND	MAXIMUM CONCENTRATION (M)
NaOH	**3.9**
$NaNO_3$	**2.8**
$NaNO_2$	**1.8**
$NaAlO_2$	**1.8**
$NaCO_3$	**0.7**
Na_2SO_4	**0.2**
Na_3PO_4	**0.5**
NH_3	**0.11**
NaF	**0.07**

Table 3. 2 Chemical Composition of Concentrated Slurry

COMPOUND	MAXIMUM CONCENTRATION (M)
NaOH	**5.5**
$NaNO_3$	**5.0**
$NaNO_2$	**2.5**
$NaA1O_2$	**2.5**
$NaCO_3$	**1.2**
Na_2SO_4	**0.3**
Na_3PO_4	**0.1**
NH_3	**0.15**
NaF	**0.6**

Table 3. 3 242-A Evaporator Bulk Chemistry Solutions

Description	Units	Evaporator Feed	Double Shell Slurry Feed	Process Condensate	Cooling Water	Steam Condensate
pH	--	13.0	13.0	10.0	6.2	8.0
TOC	mg/L	3.3 E+03	4.6 E+03	2.6 E+02	1.7 E+00	1.1 E+00
TDS	mg/L	0.0 E+00	0.0 E+00	3.4 E-01	0.0 E+00	7.6 E+01
Alpha	uCi/ML	0.0 E+00	2.9 E+11	5.7 E-11	8.1 E-10	6.5 E-10
Beta	uCi/ML	0.0 E+00	3.5 E-10	6.8 E-13	1.0 E-08	00 E+00
ALO_2	mg/L	2.2 E+04	3.2 E+04	4.1 E+01	00 E+00	00 E+00
NH_4^+	mg/L	9.3 E-02	1.3 E+02	2.3 E+03	00 E+00	6.3 E-02
Barium	mg/L	9.8 E+00	1.4 E+01	3.0 E-02	3.0 E-02	3.1 E-02
Baron	mg/L	1.2 E+01	1.7 E+01	3.5 E-02	0.0 E+00	1.8 E-02
Calcium	mg/L	5.1 E+01	7.3 E+01	1.9 E+01	1.9 E+01	1.9 E+01
Cadmium	mg/L	1.1 E+01	1.6 E+01	3.1 E-02	2.0 E-03	0.0 E+00
CO_3	mg/L	8.7 E+03	1.2 E+04	2.4 E+01	0.0 E+00	0.0 E+00
CL-	mg/L	4.5 E+03	6.4 E+03	2.4 E+01	7.8 E-01	1.1 E+00
Chromium	mg/L	4.2 E+02	6.0 E+02	3.4 E-02	1.0 E-02	0.0 E+00
Copper	mg/L	4.8 E+00	6.9 E+00	1.5 E-02	7.3 E-02	1.1 E-02
CN	mg/L	3.4 E+01	4.8 E+01	9.5 E-02	0.0 E+00	0.0 E+00
F	mg/L	2.7 E+02	3.9 E+02	4.3 E-02	0.0 E+00	1.3 E-01
Iron	mg/L	2.8 E+01	3.9 E+01	8.5 E-02	1.0 E-01	8.4 E-02
H_2	mg/L	1.6 E-11	1.7 E-11	2.0 E-11	0.0 E+00	0.0 E+00
OH	mg/L	4.9 E+04	7.0 E+04	1.4 E+02	0.0 E+00	0.0 E+00
Lead	mg/L	5.1 E+01	7.0 E+01	4.6 E+00	1.3 E-02	5.5 E-05
Magnesium	mg/L	2.0 E+01	2.9 E+01	4.6 E-01	4.3 E+00	4.5 E+00
Manganese	mg/L	2.0 E+01	2.9 E+01	5.8 E-02	1.1 E-02	1.4 E-02

Description	Units	Evaporator Feed	Double Shell Slurry Feed	Process Condensate	Cooling Water	Steam Condensate
Mercury	mg/L	5.6 E+00	8.0 E+00	1.6 E-02	0.0 E+00	1.1 E-04
Molybdenum	mg/L	4.2 E+01	6.0 E+01	1.2 E-01	0.0 E+00	0.0 E+00
Nickel	mg/L	2.8 E+01	4.0 E+01	7.9 E-02	1.1 E-02	0.0 E+00
NO_3	mg/L	1.2 E+05	1.8 E+05	6.1 E+01	1.2 E+00	5.5 E-01
NO_2	mg/L	6.0 E+04	8.6 E+04	7.0E+01	0.0 E+00	0.0 E+00
PO_4	mg/L	3.7 E+03	5.3 E+03	1.0 E+01	0.0 E+00	0.0 E+00
Phosphorus	mg/L	3.4 E+03	4.9 E+03	9.6 E+00	0.0 E+00	0.0 E+00
Potassium	mg/L	1.3 E+04	1.8 E+04	1.0 E+01	8.0 E-01	7.5 E-01
Silicon	mg/L	1.3 E+02	1.9 E+02	5.9 E-01	0.0 E+00	2.5 E+00
Sodium	mg/L	1.7 E+05	2.4 E+05	1.6 E+01	2.3 E+01	2.2 E+00
SO_4	mg/L	2.0 E+03	2.9 E+03	5.0 E+00	1.0 E+01	1.0 E+01
Tungsten	mg/L	1.5 E+02	2.1 E+02	4.1 E-01	0.0 E+00	0.0 E+00
Uranium	mg/L	5.3 E+01	7.5 E+01	1.5 E-01	6.4 E-04	52 E-04
Zinc	mg/L	3.4 E+1	4.8 E+01	9.6 E-02	4.8 E-02	1.9 E-02

Table 3. 4 Operating Parameters

COMPONENT	PRESSURE/FLOW	**TEMPERATURE (°F)**
C-A-1 Evaporator		
Vapor Section	<0.8 psia (0.06 kg/cm^2)	**120**
Lower Circulation Pipe	14,000 gpm (53,000 liter/min)	**200**
E-A-1 Reboiler		
Tube Side (Waste)	14,000 gpm (53,000 liter/min)	**200**
Shell Side (Steam)	29.7 psia (2.08 kg/cm^2)	**250**
E-C-1 Primary Condenser		
Tube Side (Cooling Water)	3,500 gpm (13,249 liter/min)	**72**
Shell Side (Waste Vapor)	0.8 psia (0.06 kg/cm^2)	**95**
E-C-2 Intercondenser		
Tube Side (Cooling Water)	150 gpm (568 liter/min)	**72**
Shell Side (Waste Vapor)	1.0 psia (0.07 kg/cm^2)	**150**
E-C-3 Aftercondenser		
Tube Side (Cooling Water)	150 gpm (568 liter/min)	**95**
Shell Side (Waste Vapor)	14.0 psia (1.0 kg/cm^2)	**170**
TK-C-100 Condensate Catch Tank	14.0 psia (1.0 kg/cm^2)	**151**

Table 3. 5 Letter Certifying Compatibility of Piping Materials with Dangerous Wastes and Dangerous Wastes List

WHC-SD-WM-ER-112
REVISION 0

• 05-21-1993 16:31 8003657473 FIBERCAST. SAND SPRINGS P.01/01

Fibercast Company
P.O. Box 968
Sand Springs, Oklahoma 74063-0968
(918) 245-6651 Telex 49-7403

Fibercast

May 21, 1993

KAISER ENGINEERING HANFORD COMPANY
P. O. Box 888
Richland, WA 99352

Attention: Ms. Penny Harvey

Gentlemen:

SUBJECT: Your Inquiry No. K51874-22

We certify that the epoxy piping we supplied for this project is compatible for use with the chemicals listed in ECN 251.*

We do not expect the concentrations of the chemicals listed in ECN 251 to damage the piping.

Very truly yours,

R. A. Sparks

R. A. Sparks
General Manager and
Vice President, Quality Assurance

RAS/td

cc: David M. Meehan
Carl E. Martin

* ECN 251 - Engineering Change Notice 251 updated the effluent characterization data in appendix D of the procurement specification (W-105-P1, Rev. (0)) to match data in the functional design criteria (WHC-SD-W105-FDC-0013, REV(1)). (by. W.J. KARWOSKI)

E-2

Table 3. 6 Effluent Characterization Data 242-A Evaporator PC

Parameter	Units	Average	90% CI	Maximum
Flow	gal/min	60		75
Annual Flow	(Mgal/yr)	20		
Temperature	(°C)	27.9		39
Conductivity	(μs)	304		590
pH		10.1		11.3
Ignitability	(°F)			
TOC		42,024	218,415	4,920,000
TOX (as Cl)	ppb			
TDS	ppb			2700
Aluminum	ppb	1295	1330	4992
Ammonium	ppb	482,511	511,344	9,350,000
Ammonia	ppb			
Barium	ppb	6.8	7.2	8
Boron	ppb	65	97	151
Calcium	ppb	2600	2800	8300
Carbonate	ppb	98000	104,347	750,000
Chloride	ppb	1000	1200	2300
Chromium	ppb	52	66	156
Copper	ppb	60	67	127
Cyanide	ppb			
Fluoride	ppb	874	971	12273
Iron	ppb	112	131	503
Magnesium	ppb	122	153	3670
Manganese	ppb	5		
Mercury	ppb	0.3	0.31	0.69
Phosphorus	ppb	1177	1336	6195
Nickel	ppb	14	15	17
Nitrate	ppb	2800	2292	5000
Potassium	ppb	5944	6495	19238
Silicon	ppb	15,616	24,252	985,819
Sodium	ppb	3586	4469	51,497
Sulfate	ppb	2600	2800	13000
Sulfide	ppb	36000	66,000	66,000
Uranium	ppb			
Vanadium	ppb	6.3	6.7	7
Zinc	ppb			
Acetone	ppb	980	1000	5100
Benzyl alcohol	ppb	13	14	18
Benzaldehyde	ppb	23		
2-Butoxyethanol	ppb	380	400	920
Butoxyethanol	ppb			
1-Butanol	ppb	9800	11,000	88,000
2-Butanone	ppb	51	53	120
Butoxyglycol	ppb	280	290	810

Parameter	Units	Average	90% CI	Maximum
Butoxydiglycol	ppb	19	44	27
Butoxytriethylenglycol	ppb	35		
Butylated hydroxyltoluene	ppb			
Butoxyaldehyde	ppb	56	62	230
Chloroform	ppb	14	14	27
Caprole acid	ppb	70		
3,5-di-methylpyridine	ppb	21	23	24
Dimethylnitrosaline	ppb	57		
Dibutylphosphate	ppb			
Dodecane	ppb	43	52	46
Ethoxy triethyleneglycol	ppb	99	120	150
Ethyl alcohol	ppb	2		
Hexadecane	ppb	17		
Heptadecane	ppb	18		
Methoxydiglycol	ppb	40	52	52
Methoxytriglycol	ppb	220	370	370
Methylene chloride	ppb	120	140	180
Methyl n-propyl ketone	ppb	9.3	9.7	12
Methyl n-butyl ketone	ppb	13	14	79
Methyl isobutyl ketone	ppb	11	14	68
2-Methyl-nonane	ppb	16	17	17
Pentadecane	ppb	20		
Phenol	ppb	33		
2-Propanol	ppb	22	24	39
Pyridine	ppb	550		
Tetradecane	ppb	76	83	440
Tetrahydrofuran	ppb	37	39	170
Tributyl phosphate	ppb	3900	4100	21,000
1,1,1-trichloroethane	ppb	5		
Tridecane	ppb	70	77	350
Triglyme	ppb	90		
Undecana	ppb			
Unknown				
Unknown – alphatic HC				
Unknown ester				
Unknown ester				
Alpha	pCi/L	160	350	750
Beta	pCi/L	4600	6000	74,000
^{90}Sr	pCi/L	520	760	8100
^{106}Ru	pCi/L	10500	11,080	17,800
^{103}Ru	pCi/L			
^{134}Cs	pCi/L			
^{137}Cs	pCi/L	440	540	2600
^{147}Pm	pCi/L	1300	1600	4100
Uranium (gross)	pCi/L	20	33	140
^{3}H	pCi/L	5,600,000	6,300,000	24,000,000

Parameter	Units	Average	90% CI	Maximum
^{241}Am	pCi/L			
^{129}I	pCi/L			
^{238}Pu	pCi/L			
^{241}Pu	pCi/L			
^{239}Pu	pCi/L	0.00037	0.00068	0.0024
^{113}Sn	pCi/L	540	770	2500
^{155}Eu	pCi/L	1400	na	1400

Notes:

1. Abbreviations:
   Mgal = millions of gallons
   °C = degrees Celsius
   gal/min = gallons per minute
   TDS = total dissolved solids
   pCi/L = picocuries per liter
   ppb = parts per billion
   mS = Mictrosiemen
   SU = Standard pH units
   TOC = total organic carbon
   Mgal/yr = million gallons per year

Source: WHC 1993c.

4.0 DESIGN AND OPERATING INFORMATION

The following subsections describe the design and operating information for the 242-A Evaporator and PC-5000 Transfer Line.

4.1 242-A Evaporator System

The following subsections describe the design codes and standards that the system was designed to; the original basis of design; structural support features of the system; existing waste compatibility information; existing pressure control information; existing secondary containment features; ancillary equipment associated with each subsystem; existing corrosion protection measures; and ongoing inspection activities.

4.1.1 Design Codes and Standards

Design codes and standards for the construction of the 242-A Evaporator System were included in the original design specifications from RHO-SD-WM-TI-003, Rev. 0, 1972 (LMHC 1998b). The principal design standards in the original design included the following:

- ASME Section VIII, Division 1 (1972)
- Uniform Building Code (1972)
- Hanford Plant Standard "M" piping codes

Design loads were established by Hanford Plant Standard, SDC-4.1 (U.S. DOE 1989). Table 4-1 includes a complete list of the design standards and design criteria included in the original specifications. Also included in Table 4.2 is a listing of the specific "M" piping codes used on the project. These design codes and standards will be reviewed during the integrity assessment to determine if there have been any significant changes to the referenced codes and standards that might affect the integrity of the system.

4.1.2 Basis of Design

Construction of the 242-A Evaporator System was completed in 1977. The TSD unit's original design life was ten years. The TK-C-100 Condensate Collection Tank was fabricated in 1951 as part of another project but was never used. The tank was upgraded in 1977 to be consistent with the 242-A Evaporator System design standards and installed in the 242-A TSD unit. As a result of Project B-534 (LMHC, 1998b), some TSD unit components were upgraded or replaced. These components were:

- E-C-1 Primary Condenser 1990
- P-B-1 Pump 1990
- P-B-2 Bottom Pump 1990
- Miscellaneous Process Piping 1990

Other major upgrades completed since 1990 were:

- Replacement of E-C-2 and E-C-3 in 2004
- Removal of Ion Exchange Column in 2003

The components upgraded in 1990 were evaluated in the 1993 IAR. Section 4.1 of the 1993 IAR states that Design Standards were considered as part of the assessment and a letter report included in the Data Package (WHC 1993b). The 1998 IAR (LMHC 1998b) states that "The review and evaluation of the codes and standards performed for the 1993 IAR is sufficient for this report".

The 1993 IAR did not involve structural analysis for many of the waste stream system components (WHC-1993b). The report stated that most of the components were ASME Code stamped, thereby testifying that these items have been designed to Code requirements. However, documentation has not been located which verifies the adequacy of the waste piping from anchor to anchor under seismic loading conditions. This report requires visual inspection of waste stream piping system supports, within the scope of this report, to ensure no evidence or signs of deterioration, corrosion or cracking.

Since it has been approximately 13 years since the codes and standards have been evaluated, this integrity assessment will compare the codes and standards to the current design standards if any changes occurred since 1993. The comparison will identify differences (if any) in the current codes and standards that potentially impact the physical requirements of a Dangerous Waste subsystem. The Design Standards evaluation will evaluate operational loads against allowable loads to verify the TSD unit is operating within design standards. Off-normal reports will be included in the Design Standards evaluation.

The Dangerous Waste subsystem components will be evaluated to determine age in calendar years and in hours of operation. Operating Contractor records will be reviewed to identify components that have been replaced since that last IAR. The age and hours of operation for the components will be instrumental in developing corrosion rates of components based on ultrasonic thickness comparisons with the past two integrity assessments. Table 4-3 provides comparison of the two sets of UT data collected in 1993 and 1998 integrity assessment with the standards for the evaporator/reboiler loop, condensate collection tank, and process condensate condensers. Table 6.1 and Figures 6.3 through 6.7, 6.12, 6.15, 6.19, and 6.20 provide the UT testing locations for the measurement of wall thicknesses for the vapor liquid separator subsystem. Table 6.1 and Figures 6.8 through 6.11, 6.13, 6.14, 6.15, and 6.16 through 6.18 provide the UT testing locations for the measurement of wall thickness for condensate collection subsystem. This information will also be used in developing a schedule for conducting the next integrity assessment.

4.1.3 Structural Support Features

Technical specifications were not reviewed in the 1993 and 1998 IARs. The 1998 IAR, based on findings, recommended future integrity assessment frequency and recommended an assessment as shown on 2.6.2 of the 1998 IAR. The 1993 IAR, section 7.1, 6th bullet stated: "The facility design and construction provide adequate protection for the environment and for workers and public health and safety in the event of internal system failures and process upsets with single possible exception of the primary sump which may require secondary contamination".

This IA will not attempt to get existing calculations. Documentation will be obtained from CH2M HILL and reanalysis (where necessary) of critical components of the 242-A Evaporator TSD unit and piping systems for seismic qualification will be completed to meet the deficiency in the 1993 IQRPE certification.

4.1.4 Waste Compatibility

The waste fed to the 242-A Evaporator is regulated as a mixed waste with the same waste constituents as the waste in the DST System. The concentrated slurry is a characteristic waste (D001, D002, and D003), toxic waste (D004 through D011, D018, D019, D022, D028 through D030, D033 through D036, D038 through D041, and D043), nonspecific source waste (F001 through F005 and F039), and state-only characteristic waste (WT01, WT02, WP01, WP02) as per Part A Form (Permit # WA 7890008967 Part III Operating Unit 4, Chapter 1) (Ecology 2004a). Multi-source leachate (F039) is included as a waste derived from nonspecific source waste F001 through F005.

The process condensate is regulated as a mixed waste due to the toxicity of ammonia (WT02) and because it is derived from the waste with a nonspecific source wastes F001 through F005 as per Part A Form (Permit # WA 7890008967 Part III Operating Unit 4, Chapter 1) (Ecology 2004a). Multi-source leachate (F039) is included as a waste derived from nonspecific source waste F001 through F005.

All waste to be processed at the 242-A Evaporator must be sampled to determine if the waste is compatible with the materials of construction at the 242-A Evaporator. Before each campaign, candidate feed tanks are sampled per the requirements of the waste analysis plan (Ecology 2004a). Based on the results, three possible options are implemented.

- The waste is acceptable for processing without further actions.
- The waste is unacceptable for processing as a single batch, but is acceptable if blended with other waste that is going to be processed.
- The waste is unacceptable for processing.

WAC 173-303-395 requires waste handling be conducted to prevent an uncontrolled reaction that could damage the tank system structural integrity or threaten human health or the environment. To evaluate the possibility of an uncontrolled reaction at the elevated temperatures in the evaporator vessel, a differential scanning calorimeter (DSC) test is performed on sample of all candidate waste to be processed. DSC measures the amount of heat absorbed or released by a sample as the temperature is increased. Waste exhibiting exotherms below 168°C, or with an absolute value of the exotherm-to-endotherm ratio greater than one, will not be processed in the 242-A Evaporator without further technical evaluation.

To verify there will be no adverse affects because of mixing the contents of different waste tanks in the feed tank and evaporator vessel, a compatibility evaluation is performed on waste in the candidate feed tanks. As samples from each of the planned waste sources are mixed, observations are made to note any changes in color, temperature, clarity, or any other visually determinable characteristic. This would indicate an unexpected chemical reaction that might have an impact on 242-A Evaporator operations. If such visible changes are observed when mixing samples, the waste would not be processed in the 242-A Evaporator.

A corrosion evaluation based on the UT data collected for the 1998 IAR verified that the chemistry of the waste streams introduced to the 242-A Evaporator have had a minimal effect on the equipment and agreed with the conclusions of corrosion evaluation in the 1993 IAR.

Current data gathered during the examination of the tank system by visual and UT inspections will be used in addition to waste characterization, tank system age, and tank system materials, and corrosion control measures to perform an evaluation of existing corrosion protection and waste/tank compatibility for the 242-A Evaporator subsystems. The assessment will compile a listing of all of the tank system materials and analyze the corrosion potential for each material in the waste stream environment under the projected corrosive concentrations. Corrosion protection measures for the materials of the 242-A Evaporator system are discussed in Section 4.1.8.

4.1.5 Pressure Control Features

Ecology (1995) requires that an IQRPE certify that the existing tank system has been designed with appropriate pressure control systems. Pressure control system for each subsystem of the 242-A Evaporator will be identified and evaluated for their performance and design to meet the Ecology (1995) requirements

4.1.6 Secondary Containment Features

A detailed discussion of the secondary containment features for the 242-A Evaporator is provided in Section 3.1.1.3. This system is designed to ensure any release is detected within 24 hours. The secondary containment system also is designed to contain 100 percent of the maximum operating capacity of the vapor-liquid separator/reboiler loop, and the drain systems are sloped to allow collection of solution and have sufficient capacity to drain this volume in less than the required 24 hours.

Ecology (1995) requires that an IQRPE certify that the existing tank system has been designed with appropriate secondary containment systems. Secondary containment for tank systems that store, accumulate, or treat dangerous waste must be designed and installed to meet the requirements of WAC 170-303-640(4)(b). There are no double walled tanks designed to contain dangerous waste within the 242-A Evaporator TSD unit. The Evaporator building structure and the associated sump and drain systems are the secondary containment systems for the 242-A Evaporator TSD unit. These secondary containment systems will be reviewed and evaluated for adequacy of the system to contain dangerous waste for IQRPE certification.

4.1.7 Ancillary Equipment

All P&IDs will be reviewed for the following basic considerations and reported in the IAR if any deficiencies were found:

- Appropriate location of pressure, temperature, and flow sensing equipment
- Necessary piping, valve, and instrumentation labeling
- Proper positioning of instrumentation to prevent undue influence from upstream equipment
- Necessary isolation valves to allow instrumentation maintenance
- Identification of preliminary interlocks
- Designation of valves as fail-open or fail-close
- Location of check valves or back-flow preventers
- General designation of appropriate alarms and recorded information

4.1.8 Corrosion Protection Features

Material that comes in contact with the Dangerous Waste was selected to withstand the characteristics of the waste. Primary containment material is stainless steel within the building. Secondary containment consists of lined or coated concrete sumps or vaults within the building.

Since the majority of the 242-A subsystems are not in contact with the soil with exception to the secondary external concrete, no external corrosion evaluation is required with the exception of 242-A building drain lines. These drain lines are within the 242-A Evaporator TSD unit. Internal corrosion is a potential that requires evaluation.

The 242-A Building serves as a secondary containment vault for the vapor-liquid separator (C-A-1), condensate collection tank (TK-C-100), and ancillary equipment used for transferring mixed waste at the 242-A Evaporator. Before restart in 1994, a new acrylic special protective coating was applied to the concrete in the pump, evaporator, and condenser rooms. The coating meets the requirements of the construction specifications (Vitro 1974), including resistance to high radiation integrated doses, temperatures of 77°C (171° F) and spills of 25 percent caustic solution. The pump room floor is lined with 0.64-centimeter (0.25-inch) stainless steel and the concrete walls and ceiling cover blocks are painted with a special protective coating. The floor and walls of the evaporator room up to an elevation of 1.8 meters (5.9 feet) are painted with a special protective coating. The floor and walls of the condenser room up to an elevation of 1.2 meters (3.94 feet) are painted with a special protective coating.

The sumps, floor, and walls of the load out and hot equipment storage room up to an elevation of 3.8 meters (12.47 feet) are painted with a special protective coating. The 242-A building external drain lines are connected to a cathodic protection system to prevent external corrosion from contact with the soil. The cathodic protection system consists of:

- A rectifier that converts supplied alternating current voltage to an adjustable direct current voltage.
- Numerous anodes buried near the underground piping and connected to the rectifier.
- Return wiring that connects the piping to the rectifier, completing the circuit.

The rectifiers are inspected to assure component degradation has not occurred. Test stations along the system are checked annually to verify 0.85 volt is maintained on the system, as required by the National Association of Corrosion Engineers.

There is no cathodic protection for any of the dangerous waste subsystems.

4.1.9 Ongoing Inspection Activities

To monitor critical components (components that are in contact with radioactive waste stream) containment integrity, the 242-A Evaporator uses radiation monitors to continuously monitor effluent streams for excessive radioactive contamination. The presence of excessive radioactive contamination in the effluent streams would indicate a breach of one of the primary containment boundaries. Continuous monitoring systems are provided at the following location:

- Process Condensate Subsystem—Continuous monitoring of this subsystem diverts the process condensate to the feed tank or the condensate collection tank in the event of excessive radiation being detected in the stream.

Additionally, administrative procedures are used to control and monitor process flow for indication of process upsets through material balance calculations and operation data sheets. These data are combined with periodic sampling of the Dangerous Waste streams and continuous monitoring of the 242-A Evaporator non-regulated effluents and emissions regulated under 40 CFR 264, Subpart AA (see Permit # WA 7890008967 Part III Operating Unit 4, Chapter 4).

4.2 PC-5000 Condensate Transfer Line

The following subsections describe the design codes and standards that the system was designed to; the original basis of design; structural support features of the system; existing waste compatibility information; existing pressure control information; existing secondary containment features; ancillary equipment associated with each subsystem; existing corrosion protection measures; and ongoing inspection activities.

4.2.1 Design Codes and Standards

The functional design criteria document (WHC 1991a) is the design control document. It cites federal and national codes and standards as controlling documents for the design, installation, and documentation of the transfer piping.

The key applicable drawings are listed in Attachment A.

The procurement specifications for the piping are provided in the reference W-105-P1. Kaiser Engineers Hanford Company incorporated Hanford Plant Standard SDC 4.1 design criteria (U.S. DOE 1989) into the procurement specification. WHC (1993c) also summarized that the waste transfer piping system was designed, fabricated, tested, and installed as per the requirements of ANSI B31.3-1987 Edition with Addenda.

4.2.2 Basis of Design

The waste transfer piping system was designed, fabricated, tested, and installed as per the requirements of the principal design and fabrication standards cited in the procurement specifications (WHC 1991a). These are:

- ANSI B31.3 – 1987 Edition with Addenda ANSI B31.3A, B31.3b, and B31.3c, "Chemical Plant and Petroleum refinery Piping" (ANSI 1987)
- American Water Works Association (AWWA) C950-88, AWWA standard for Fiberglass Pressure Pipe" (ANSI 1989)

4.2.3 Structural Support Features

The 7.6 centimeter (3 inch) diameter carrier pipe is encased in a 15.2 centimeter (6 inch) diameter containment pipe and supported within that pipe by spacers located on approximately 2.13 meter (7 feet) centers. The double containment piping system passes under Canton Avenue at one location. At that location, the top of the15.2 centimeter (6 inch) diameter encasement pipe is 1.22 meter (4 feet) below street grade. The supplier, Fibercast Company, recommended a minimum depth of burial of 2-feet (0.61-meter). At the minimum depth, the pipe is capable of sustaining the Standard AASHTO-H2O-S16 (AASHTO 1989) truck loading, 14,528 kg (32,000 lbs) per axle. At other locations, the pipe is buried deeper than 1.22 meter (4 feet) except at the LERF basin where vehicular traffic/access is restricted.

The Fibercast Company specifications pertain to buried flexible piping where the pipe, trench walls, and bedding material work together to form a complete pipe support system. The transfer piping is placed on either 15.2 centimeter (6-inch) of compacted sand or undisturbed sand along its entire buried route. Holes are pared in the trench bottom for pipe couplings, so that the pipe will bear along the full length of barrel or section. This provides for uniform support of the buried piping system.

The specifications for the selection and emplacement of backfill material under and around buried pipes are controlled by the Construction Specification W-105-C3, Division 2, Section 02200, Earthwork (WHC 1991b). The backfill is placed according to Washington State Department of Transportation (WSDOT) M41-10, Section 2-03.3(14)C, Method C (WSDOT 1988).

4.2.4 Waste Compatibility

The 242-A Evaporator process condensate is a dilute aqueous solution with ammonia, volatile organics, and trace quantities of radionuclides and inorganic constituents generated from the treatment of double shell tank waste by the 242-A Evaporator. The waste stream is classified as a Washington State Dangerous Waste. The chemical components that the piping system was designed to be compatible with are those given in Table 3.6, Section 3.2.4. The piping supplier submitted a letter stating that the pipe material is compatible with the chemical components or dangerous wastes as delineated in Table 3.5 (WHC 1993c). Current waste characteristics data will be collected from implementation of the 242A Evaporator Waste Analysis Plan (Permit # WA 7890008967 Part III Operating Unit 4, Chapter 3) or other sources and evaluated for waste compatibility with the piping material. The waste acceptance criteria for process condensate sampling, including treatability, LERF liner compatibility, compatibility with other waste, etc., is given in the LERF RCRA Permit (Ecology 2004b).

4.2.5 Pressure Control Features

Six 0.91 meter (3 feet) long leak detection sensors are provided in the annulus of the double-encased evaporator condensate stream transfer line. These leak detectors are spaced at a maximum distance of 305 meter (1,000 feet) along the transfer line. The jumper cable connecting the leak detection sensors is inside a conduit buried alongside the pipeline. The monitoring and control system (MCS) is located in the 242-A building control room. If a leak is detected, the alarm and location of the leak is indicated at the MCS.

Upon detection of a leak, pump P-C100 is automatically stopped. Valve HV-RC3-3 is automatically repositioned to divert flow from being transferred from the LERF to 241-AW-102. This shutdown condition can be overridden by inputting the proper commands at the 242-A Evaporator MCS.

The PC-5000 transfer line normally is continuously monitored during transfers by a leak detection system (Attachment 34, Chapter 4.0; Ecology 2003). The alarms on the leak detection system are monitored in the ETF control rooms. As an alternative to continuous leak detection, the transfer lines can be inspected daily during transfers by opening the secondary containment drain lines at the LERF catch basins (for 242-A Evaporator transfers to LERF) and the surge tank (for LERF transfers to ETF) to inspect for leakage.

4.2.6 Secondary Containment Features

A 6-inch (15.2-centimeter) diameter pipe provides secondary containment in the event there is a failure of the inner pipe. An annular space is maintained between the inner and outer pipe by spacers that are located every 2.13-meter (7 feet) along the length of the inner pipe. The annular space between the inner pipe and the outer pipe provides space for the leak detection system, and an unrestricted path for liquid to drain to swab risers that are located every 30.5-meter (100 feet) along the transfer line. A detailed discussion of secondary containment and leak detection system for the PC-5000 transfer line is provided in Section 3.2.3.

Prior to each campaign attempts are made to operate the PC-5000 line automated leak detection system. Although continued attempts to maintain the automated system are made, the system has a history of false alarms. Alternative leak detection (visual inspection at the LERF end of the line) has been utilized since 2003.

Since the system was installed and operational, secondary containment system for the PC-5000 transfer line was not evaluated for its system integrity The 1993 integrity assessment report (WHC 1993c) assessed and concluded based on procurement specifications and functional design criteria that the PC-5000 transfer line (originally called as waste transfer piping) and secondary containment system was designed, fabricated, tested, and installed as per the requirements of ANSI B31.3, 1987 Edition and with Addenda. The PC-5000 transfer line was not evaluated in the 1998 IAR. The 1998 IA was for the 242-A Evaporator TSD unit alone, and the PC-5000 transfer line was not included as it was not part of the 242-A TSD boundary at that time. PC-5000 was, in fact, part of the LERF TSD unit and subject to impoundment facility requirements. During this integrity assessment, the performance of the secondary containment and leak detection system will be evaluated and the evaluation procedures are detailed in Section 6.2.

4.2.7 Ancillary Equipment

The ancillary equipment associated with the PC-5000 transfer line are listed below:

- Process condensate transfer pump
- Flow control valve
- Electronic leak detection elements
- Conductivity sensors
- Low volume air purging instrumentation
- Monitoring Control System (MCS) at the 242-A Evaporator

All P&IDs for the PC-5000 transfer line will be reviewed for the following basic considerations and reported in the IAR if any deficiencies were found:

- Necessary piping, valve, and instrumentation labeling
- Proper positioning of instrumentation to prevent undue influence from upstream equipment
- Necessary isolation valves to allow instrumentation maintenance
- Identification of preliminary interlocks
- Designation of valves as fail-open or fail-close
- Location of check valves or back-flow preventers
- General designation of appropriate alarms and recorded information

4.2.8 Corrosion Protection Features

The transfer piping system is fabricated from centrifugally-cast fiberglass-reinforced epoxy thermoset resin manufactured as per ASTM D 2997 (ASTM 1989). It contains no metal components or dangerous wastes as delineated in Table 3.5.

Corrosion protection of the transfer piping is provided through material selection. Fiberglass-reinforced epoxy is a chemically inert material that is not expected to be degraded by the intended waste solution. Installation of additional corrosion protection such as coating, cathodic protection, or corrosion inhibitors is not applicable.

The 1993 IAR stated that the piping material and waste characteristics have been reviewed by WHC corrosion engineers. Review of a field fabricated corrosion protective system by an independent corrosion expert is required by law. Since there was no system installed to protect the pipe, there is no requirement for the independent corrosion expert to review transfer piping.

4.2.9 Ongoing Inspection Activities

To monitor critical components and containment integrity, the PC-5000 Process Condensate Transfer Line uses six 0.91-meter (3-feet) long leak detection sensors in the annulus of the double encased transfer line to continuously monitor the leak and a monitor and control system (MCS) located in the 242-A building control room. If a leak is detected, the alarm and location of the leak is indicated at the MCS.

Upon detection of a leak, pump P-C100 is automatically stopped. Valve HV-RC3-3 is automatically repositioned to divert flow from being transferred to the LERF. This shutdown condition can be overridden by inputting the proper commands at the 242-A Evaporator MCS.

The presence of excessive leak would indicate a breach of the primary containment transfer line boundaries.

Prior to each campaign attempts are made to operate the PC-5000 line automated leak detection system. Although continued attempts to maintain the automated system are made, the system has a history of false alarms. Alternative leak detection (visual inspection at the LERF end of the line) has been utilized since 2003.

Table 4. 1 Equipment Design Criteria

COMPONENTS	DESIGN CRITERIA	COMMENTS
C-A-1 Evaporator	Standard(s): ASME Section VIII Div. 1, HPS 230W & 220W Temperature: 200° F Pressure: Full Vacuum Materials: ASTM SA 240 304L (Shell) Reference: Construction Spec. B-100-P1, SD-WM-TI-003	Designed by Struthers Nuclear and Process Co.
E-A-1 Reboiler	Standard(s): ASME Section VIII Div. 1, HPS 230W & 220W Temperature: 350°F (Shell), 250°F (Tubes) Pressure: 100 psig (7 kg/cm^2) (Shell), Full Vacuum (Tubes) Materials: ASTM SA 240 304L (Shell) Reference: Construction Spec. B-100-P1, SD-WM-TI-003	ASTM SA 312 304 (NOZZLES)
P-B-1 Recirculation Pump	Standard(s): Not Specified Temperature: 200°F Total Head: 4 meter (13.2 feet) Materials: ASTM A296 Gr CF-8 and GrGF-8 Reference: Procurement Spec. B-534-P4 Capacity: 14,000 GPM (52,990 LPM)	New Installation per Project B-534 (FMD-T-6000-00001) page 18
P-B-2 Bottoms Pump (Slurry Pump)	Standard(s): Not Specified Delete	New Installation per Project B-534

COMPONENTS	DESIGN CRITERIA	COMMENTS
	Temperature: 155 °F Pressure: 152 meters (500 feet) Materials: Stainless Steel Flow: 121 - 416 liters per minute (32 to 110 gpm) Reference: Procurement Spec. B-534-P11	
E-C-1 Primary Condenser	Standard(s): ASME Section VIII Div. 1, HPS 220W Temperature: 150°F (Shell and Tubes) Pressure: Full Vacuum (Shell), 100 psig (7 kg/cm^2) (Tubes) Materials: SA285 GrC (Shell Heads, Internal Supports) Reference: Construction Spec. B-100-P1	SA 515 GR70 (tubes). Original unit replaced by unused spare on Project B-534.
E-C-2 Intercondenser	Standard(s): ASME Section VIII Div. 1, TEMAC Temperature: 350°F (Shell and Tube) Pressure: 7 kg/cm^2 (100 psig) to Full Vacuum (Shell), 100 psig (7 kg/cm^2) (Tube) Materials: Carbon Steel Reference: Shutte and Koerting Co. Spec. Sheet 72-T-018-J-1	E-C-2 was replaced in 2004.

COMPONENTS	DESIGN CRITERIA	COMMENTS
E-C-3 Aftercondenser	Standard(s): ASME Section VIII Div.1, TEMAC Temperature: 350°F Pressure: 100 psig (7 kg/cm^2) to Full Vacuum (Shell), 100 psig (7 kg/cm^2) (Tube) Materials: Carbon Steel Reference: Shutte and Koerting Co. Spec. Sheet 72-T-018-J-1	E-C-3 was replaced in 2004.
TK-C-100 Condensate Catch Tank	Standard(s): ASME Section VIII Division 1 & HWS 4311, Revision 2 Temperature: Ambient Pressure: 5 psig (0.35 kg/cm^2) Materials: 347 SS Reference: H-2-69357 & H-2-40704	Modified in 1977 per ASME Sec. VIII Div. 2 New material ASTM A312 Type 304. 1124 gallon (4254 liter) capacity
TK-C-103 Condensate Measurement Tank	Standard(s): ASME Section VIII Div. 1 Temperature: Not Available Pressure: Atmospheric Materials: ASTM A36 (Wier Plate ASTM A240 304L) Reference: H-2-69370	500 Gallon (1893 liter) tank
Seal Pot, Liquid Seal	Standard(s): ASME Section VIII, Div. 1 Temperature: Not Available Pressure: Atmospheric	27 (102 liter) Gallon tank

COMPONENTS	DESIGN CRITERIA	COMMENTS
	Materials: ASTM A36 CS Reference: H-2-69368	
Building/Structure	Standard(s): UBC, 1972 Temperature: N/A Pressure: N/A Materials: Poured in-place concrete Reference: Structural Dwgs. H-2-69276 thru 85 and H-2-69269 thru 75 and H-2-90739 thru 41	Seismic Design Loads: Horizontal, 0.25g DBE/0.125g OBE, Vertical, 2/3 horizontal. Coated with phenoline 305 chemically resistant coating.

Table 4. 2 Pipe Materials

SYSTEM DESIGNATOR	MATERIAL
M1	ASTM A53, TYPE E OR S, GR A OR B, OR ASTM A106, GR A OR B
M2	ASTM A53, TYPE E OR S, GR A OR B, OR ASTM A106, GR A OR B
M5	ASTM A53, TYPE E OR S, GR A OR B, OR ASTM A106, GR A OR B
M7	ASTM A53, TYPE E OR S, GR A OR B, OR ASTM A106, GR A OR B
M8	ASTM A312, TP304L
M9	≤12" (30.5 cm): ASTM A312, GRTP304L, ≥14" (36 cm): ASTM A240, GRTP304L
M21	SS 304L, PER HPS-124-M
M24	ASTM A53, TYPE S, GR B, OR ASTM A106, GR B
M25	ASTM A53, TYPE S, GR B, OR ASTM A106, GR B
M27	SS ASTM A312, TYPE 304L
M31 (TUBING)	.035" (9 mm) WALL THK, ASTM A269, GR TP304
M32 (TUBING)	POLYETHYLENE, SINGLE LINE OR BUNDLED & SHEATHED IN PVC
M33 (TUBING)	COPPER ASTM B68
M42	ASTM A53, TYPE E OR S, GR A OR B, OR ASTM A106, GR A OR B

Table 4. 3 UT Thickness and Corrosion Rate Comparison Data Collected in 1993 and 1998

Location	Equipment	Material	Nominal Tnorm, in	Tnorm - Mil Tolerance, in	1993 Readings Tavg, in	1996 Readings Tavg, in	Corrosion Rate, MPY	1993 Readings Tmin, in	1996 Readings Tmin, in	Minimum Remaining Life(5)
3	C-A-1	SS	0.375	0.32	0.381(1)	0.384(1)	0	0.35	0.381	>20
5	28" Line from C-A-1 to P-B-1 Inlet	SS	0.25	0.205	0.254(2)	0.265(2)	0	0.244	0.252	>20
7	28" Line from E-A-1 to C-A-1	SS	0.25	0.205	0.25(3)	0.252(3)	0	0.223	0.239	>20
9	E-C-1	CS	0.5	0.47	0.522(4)	0.515(4)	1.4	0.489	0.507	13.5
11	TK-C-100	SS	0.3125	0.161	0.318	0.32	0	0.309	0.312	>20
12	E-C-2	CS	0.3125	0.273	0.333	0.326	1.4	0.314	0.31	>20
13	E-C-3	CS	0.322	0.282	0.345	0.341	0.8	0.334	0.328	>20
15	6" DR-335-M9	CC	0.134	0.117	0.137	0.137	0	0.135	0.135	>20
16	3" DR-359-M42	CS	0.216	0.189	0.212	0.217	0	0.208	0.211	>20
17	6" VAC-1500-M42	CS	0.28	0.245	0.306	0.313	0	0.3	0.309	>20

Notes:
(1) Average for thickness readings from A1 to L6.
(2) Average for Section T thickness readings from A1 to D10.
(3) Average for Section U thickness readings A1 to D9.
(4) Average for thickness readings from A1 to M11.
(5) This remaining life is based on the minimum measured thickness (in 1993 or 1998), the average corrosion rate and the Tnom-Tmill Tolerance thickness. When this thickness is approached, an actual Tmin based on the design pressure and applicable codes can be determined, which will probably indicate a significantly greater remaining life.

Source: LMHC. 1998b.

5.0 INTEGRITY ASSESSMENT METHODOLOGY

An IAR will be prepared separately for the 242-A Evaporator System and PC-5000 Transfer Line. The IAR for the 242-A Evaporator System will typically include the following major sections:

- Section 1—Introduction
- Section 2—Assessment
- Section 3—Certification
- References
- Attachment 1—Drawings
- Attachment 2—Inspection Reports
- Attachment 3—Ultrasonic Testing Results
- Attachment 4—Leak Testing Results

The IAR for the PC-5000 transfer line will typically include the following major sections:

- Section 1 – Introduction
- Section 2 – Assessment
- Section 3 – Certification
- References
- Attachment 1 – Drawings
- Attachment 2 – Inspection Reports
- Attachment 3 – Leak Testing Results

This section describes the activities to be conducted in preparation of the IAR to evaluate the 242-A Evaporator and PC-5000 Process Condensate Transfer System with respect to the applicable codes, standards, and regulations; the original basis of design; applicable structural design standards; waste compatibility; pressure control; secondary containment; ancillary equipment; corrosion protection; and the basis for future recommended inspections in order to meet the requirements of WAC 173-303-640(2)(c). Field testing methodology required to support the activities described in this section are described in Section 6.0.

5.1 Codes, Standards and Regulations

In accordance with WAC 173-303-640(2)(c)(i), the codes, standards, and regulations that the system was originally designed to, as well as currently applicable codes, standards, and regulations will be evaluated to determine (a) if the system is in full compliance and if not (b) the implications of the non-compliance with respect to the integrity of the system. Codes, standards, and regulations will be referenced as necessary throughout the IAR and a complete list of references incorporated as an attachment to the IAR.

5.2 Basis of Design

In accordance with WAC 173-303-640(2)(c)(i), the basis of the design of the system will be reviewed since construction of the 242-A Evaporator was completed in 1977. The TSD unit's original design life was ten years. The TK-C-100 Condensate Catch Tank was fabricated in 1951 as part of another project but was never used. The tank was upgraded in 1977 to be consistent with the 242-A Evaporator TSD unit design standards and installed in the 242-A TSD unit. As a result of Project B-534, some TSD unit components were upgraded or replaced. These components were:

- E-C-1 Primary Condenser 1990
- P-B-1 Pump 1990
- P-B-2 Bottom Pump 1990
- Miscellaneous Process Piping 1990

These components were evaluated in the last 242-A TSD unit integrity assessment (WHC 1993a). This report states that design standards were considered as part of the assessment included in the Data Package (WHC 1993b).

LMHC (1998b) stated that the ..."The review and evaluation of the codes and standards performed for the 1993 IAR is sufficient for this report".

Since it has been approximately 13 years since the codes and standards have been evaluated, this integrity assessment will compare the codes and standards to the current design standards. The comparison will identify differences (if any) in the current codes and standards that potentially impact the physical requirements of a Dangerous Waste subsystem. The Design Standards evaluation will evaluate operational loads against allowable loads to verify the TSD unit is operating within design standards. Off-normal reports will be included in the Design Standards evaluation. The Design Standards evaluation will include a review of the design calculation package for the PC-5000 transfer line for resolution of the deficiency noted in the 1993 integrity assessment of the process condensate transfer line (WHC 1993c).

The Dangerous Waste subsystem components will be evaluated to determine age in calendar years and in hours of operation. Operating Contractor records will be reviewed to identify components that have been replaced since that last IAR. The age and hours of operation for the components will be instrumental in developing corrosion rates of components based on ultrasonic thickness comparisons with the past two integrity assessments. This information will also be used in developing a schedule for conducting the next integrity assessment.

5.3 Structural Design Standards

Due to the age of the system, the subsystems associated with the 242-A Evaporator and PC-5000 Condensate Transfer Subsystem will be evaluated to determine whether they have sufficient structural integrity and are acceptable for storing and treating dangerous waste in accordance with the requirements of WAC 173-303-640(2)(c)(i). This assessment will determine if the foundation, structural support, seams, connections, and pressure controls are adequately designed and that the tank system has sufficient structural strength, compatibility with the wastes to be stored or treated, and corrosion protection to ensure that it will not collapse, rupture, or fail in accordance with WAC 173-303-640(2)(a) and (c)(i)(ii)(iii), and (v).

The following activities will be conducted as part of the integrity assessment:

- The structural design standards and criteria used will be reviewed to ensure that they clearly and specifically reference applicable industry standards and recommended practice codes.
- Design criteria that apply to a specific tank or group of tanks will be reviewed to ensure that they are clearly indicated.

Where possible, the IQRPE will review the system components and incorporate the results of the following activities into the IAR:

- Review of the initial shell thickness requirements to determine if the original design sufficiently accounts for the observed (or calculated) corrosion rate, as well as other fabrication tolerances.
- Review of current shell thickness values
- Evaluate if shell thickness values are still adequate
- Evaluate current condition of the tank systems support per the requirements of WAC 173-303-640(2)(c)(i). This will be certified by the IQRPE as part of IAR.
- Review PC-5000 condensate line, construction and current conditions to determine if it will withstand the effects of frost heave per the requirements of WAC 173-303-640(2)(c)(i). This will be certified by the IQRPE as part of IAR.

A structural review will be prepared for each of the major subsystems associated with the 242-A Evaporator and PC-5000 Condensate Transfer Subsystem for inclusion in the IAR.

5.4 Waste Compatibility

In accordance with WAC 173-303-640(2)(c)(ii), the design of the system will be reviewed to ensure that the materials of construction are compatible with the dangerous characteristics of the waste(s) that have been and will be handled or stored or treated. The following activities will be conducted during the preparation of the IAR for the 242-A Evaporator:

- Review of the materials of construction and their current condition for the tank system to ensure that they are compatible with the wastes to be stored or treated per the requirements of WAC 173-303-640(2)(c).
- Review of the dangerous wastes or treatment reagents that may be placed into the evaporator system to ensure that they can be processed without causing the tank system to rupture, leak, corrode, or otherwise fail per the requirements of WAC 173-303-640(5)(a).
- Review of waste analysis plans to determine whether waste compatibility measures have been implemented over the years of operation.

The IQRPE will review the waste property information in conjunction with the design specifications described in Sections 5.1 and 5.2 above. The IQRPE also will review the system to ensure that it is configured to prevent freezing or precipitation of the waste materials within the system that might impact the basis for the assessment. This will include a review of pipe heat tracing, insulation and 242-A Evaporator tank heater requirements and standard operating procedures.

A completed waste compatibility evaluation is normally part of the IQRPE review, including an assessment showing that the characteristics of the waste to be stored or treated are compatible with the material properties of the tank system—including material properties of any interior lining used. A waste compatibility review will be prepared for each of the major subsystems associated with the 242-A Evaporator and PC-5000 Condensate Transfer Subsystem for inclusion in the IAR.

5.5 Pressure Control System

Due to the age of the system, the integrity assessment will include a review of the pressure control systems to ensure that these features will not result in collapse, rupture, or failure in accordance with WAC 173-303-640(2)(c). The following will be checked during the preparation of the IAR for the 242-A Evaporator:

- Review of the piping and instrumentation system to ensure that the design, construction, and current condition will allow for adequate pressure control, per the requirements of WAC 173-303-640(2)(c)(v)(B).
- Review of system design, construction, and current operating procedures to determine the following:
  - Tank capacity and design pressure.
  - The applicable characteristics of the waste to be stored.
  - Maximum inflow and outflow rates.
  - The type of roof and how it is attached to the tank.
  - Locations of pressure relief vents and other pressure controls.
  - The pressure control system discharge locations.

A pressure control system review will be prepared for each of the major subsystems of the 242-A Evaporator and PC-5000 Condensate Transfer Subsystem for inclusion in the IAR.

5.6 Secondary Containment System

Due to the age of the system, the integrity assessment will include a review of the secondary containment systems to ensure that these features will not result in collapse, rupture, or failure in accordance with WAC 173-303-640(2)(c). The secondary containment system will be reviewed to the requirements of WAC 170-303-640(4)(b). The following will be checked during the preparation of the IAR for the 242-A Evaporator:

- Review of the design, construction, and current condition of the system to determine if it is suitable to prevent any migration of wastes or accumulated liquid out of the secondary containment system to the soil, groundwater, or surface water at any time during the use of the tank system.
- Review of the design, construction, and current condition of the system to determine if it is capable of detecting and collecting releases and accumulated liquids until the collected material is removed.
- Review of the design, construction, and current condition of the materials of construction to ensure that they are compatible with the wastes to be placed in the tank system.
- Review of the design, construction, and current condition of the system to ensure that it currently has sufficient strength to withstand stresses due to static head during a release, pressure gradients, climatic conditions, nearby vehicle traffic, and other stresses resulting from daily operations.

- Review of the design, construction, and current condition of the system to ensure that the foundation or base that supports the secondary containment system will provide resistance to pressure gradients above and below the system and prevent failure due to excessive settlement, compression, or uplift.
- Review of the design, construction, and current condition of the system to ensure that it has a leak detection system that will detect the failure of either the primary or secondary containment structure or the presence of any release of dangerous waste or accumulated liquid in the secondary containment system within 24 hours.
- Review of the design, construction, and current condition of the system to ensure that it is sloped or otherwise designed or operated to drain and remove liquids resulting from leaks, spills, or precipitation.

A secondary containment system review will be prepared for each of the major subsystems associated with the 242-A Evaporator and PC-5000 Condensate Transfer Subsystem for inclusion in the IAR.

5.7 Ancillary Equipment Design

Due to the age of the system, the integrity assessment will include a review of the ancillary equipment associated with the system to ensure that these features will not result in collapse, rupture, or failure in accordance with WAC 173-303-640(2)(c). The integrity assessment will be conducted to the requirements of WAC 170-303-640(2)(c)(v)(B). The following will be checked during the preparation of the IAR:

- The Technical Specifications provide for secondary containment for tank system ancillary equipment that cannot be visually inspected for leaks on a daily basis.
- Secondary containment has been provided for flanges, joints, and valves and other connections regardless of whether or not they are welded to the piping and visually inspected for leaks on a daily basis.
- Secondary containment has been provided where pumps and valves transfer dangerous wastes between tanks regardless of whether they are seamless and can be visually inspected on a daily basis.

An ancillary equipment design review will consist of a review of the P&IDs, data sheets, and current standard operating procedures as described below. An ancillary equipment assessment will be prepared for each major subsystem associated with the 242-A Evaporator and PC-5000 Condensate Transfer Subsystem for inclusion in the IAR.

5.7.1 P&ID Review

All P&IDs will be reviewed for the following basic considerations:

- Appropriate location of pressure, temperature, and flow sensing equipment.
- Necessary piping, valve, and instrumentation labeling.
- Proper positioning of instrumentation to prevent undue influence from upstream equipment.
- Necessary isolation valves to allow instrumentation maintenance.
- Identification of preliminary interlocks.
- Designation of valves as fail-open or fail-close.
- Location of check valves or back-flow preventers.
- General designation of appropriate alarms and recorded information.

5.7.2 Data Sheet Review

Data sheets associated with the 242-A Evaporator and PC-5000 Condensate Transfer Subsystem will be reviewed for the following:

- Appropriate materials of construction
- Appropriate functionality
- Hazard classification requirements
- Appropriate pressure and temperature ratings

5.7.3 Process Control Plans Review

Campaigns of the 242-A Evaporator are conducted in accordance with Process Control Plans. These plans, from the last integrity assessment to the present, will be reviewed for the following:

- Prescribed inspection frequency
- Equipment identified for routine inspection
- Scope of inspection activities
- Results of inspection activities
- Information on waste characterization

5.8 Corrosion Assessment

The integrity assessment will include a corrosion assessment in accordance with WAC 173-303-640(2)(c)(iii). The following will be checked as part of the preparation of the IAR for the 242-A Evaporator:

- A review of the design information for the presence of any stray electrical current from nearby equipment using external power sources.
- A review of the corrosion protection recommendation for coatings and a cathodic protection system.
- A review of the provisions for corrosion allowance.

A corrosion assessment review will be prepared for each of the major subsystems associated with the 242-A Evaporator and PC-5000 Condensate Transfer Subsystem for inclusion in the IAR.

5.9 Recommended Inspection Schedule

Based on the results of the assessments completed as part of the activities described in Sections 5.1 through 5.8 above, the need for and frequency of future inspections will be determined and included in the IAR in accordance with WAC 173-303-640(2)(e).

6.0 INTEGRITY TESTING METHODS

In addition to the document reviews described in Section 5.0, the integrity assessment will include extensive field inspection and testing activities in order to meet the requirements of WAC 173-303-640(2)(c)(v)(B). The inspection and testing activities to be conducted include visual inspection (VT), non-destructive (ultrasonic [UT]) inspection, level draw down testing, and hydrostatic pressure testing. This section describes the requirements, plans, equipment, and personnel qualifications necessary to complete each of these activities for the 242-A Evaporator System and PC-5000 Process Condensate Transfer Line.

All inspections shall be performed according to the appropriate Hanford Site procedures. Inspection procedures shall be written in accordance with ASME Section V Article 5 (ultrasonic) and Article 9 (visual) and validated for use by CH2M HILL.

6.1 242-A Evaporator

The following subsections describe the integrity testing methods to be used to assess the 242-A Evaporator System.

6.1.1 Visual Inspection

Visual inspection will be performed by using naked eyes. Special tools such as video cameras, and digital still cameras will also be used to increase assessment effectiveness. Inspections will be limited only to areas that can be directly seen by the eyes.

Visual inspection of the 242-A Evaporator subsystems will be performed for evidence of degradation or deformation. This inspection will also be performed in conjunction with the level draw down testing described in Section 6.1.2 below. The visual inspection will also include a review for consistency with applicable architectural, structural, general arrangement, and piping and instrumentation drawings. Each subsystem will be walked down to inspect the condition of the major components and ancillary equipment.

The visual inspection report will include the following major sections as an Attachment to the IAR:

- Section 1—Introduction
- Section 2—Qualified Personnel, Procedures, and Equipment
- Section 3—Visual Examination Locations
- Section 4—Visual Examination Results
- Section 5—Conclusions
- Section 6—Integrity Assessment Certifications
- References
- Attachment 1—TSD Unit Location Map
- Attachment 2—Visual Inspection Location Map
- Attachment 3- Visual Inspection Forms
- Attachment 4—Letters and Memorandums
- Attachment 5—Records and Pictures
- Attachment 6—Test Data

6.1.1.1 Inspection/Walkdown Work Package

Inspection-walkdown work packages shall be prepared prior to the actual inspection and shall include the following:

- Introduction
- Scope
- Qualified Personnel, Procedures, and Equipment
- Visual Inspection Components
- Equipment
- Check List
- Quality Assurance and Safety
- Schedule
- References

This work package should describe the walkdowns to be performed on the 242-A Evaporator system to support the 242-A Evaporator Integrity Assessment. An initial walkdown should be conducted prior to actual testing of the components for level draw down leak testing, and UT examination to assess the accessible and non-accessible components and safety of components and to indicate evidence of gross degradation or deformation of components for visual, level draw down leak testing, and UT examination. For an initial walkdown, Attachment B-1 lists the components to be inspected for visual inspection.

More specifically, the external surfaces and supports of the 242-A Evaporator TSD unit components (Tank walls, Piping, Pumps, Joints, Valves, Seams, Flanges, etc.) will be inspected. Advanced equipment such as cameras (digital and video) should be used for visual inspection.

Major Components. Inspect the following:

- C-A-1 Vapor-Liquid Separator – Examine accessible ((e.g. due to lagging, ALARA, or physical barriers) surface area of Evaporator paying particular attention to welds, joints, and seams. Note areas of significant degradation or deformation. Photograph and record inspection results.
- E-A-1 Reboiler – Examine accessible surface area of the Reboiler paying particular attention to welds, joints, and seams. Note areas of significant degradation or deformation. Photograph and record inspection results.
- E-C-1 Condenser – Video record external accessible areas of the condenser paying particular attention to welds, joints, and seams. Note areas of significant degradation or deformation. Photograph and record inspection results.

Piping. Examine surface area of all accessible pipelines (Feed lines, Recirculation lines, Slurry lines, Process condensate lines, Vapor condensate lines, and Drain lines, paying particular attention to welds, joints, and seams. Note areas of significant degradation or deformation. Photograph and record inspection results.

Pumps, Instruments, Flanges, and Valves. Examine surface area of all accessible pumps, instruments such as flow indicators, pressure gages, valves, and flanges, paying particular attention to welds, joints, and seams. Note areas of significant degradation or deformation. Photograph and record inspection results.

Structural Supports. Examine structural supports (Pipe hangers, etc.) for evidence of overstressing and gross differences between design drawings and actual configuration. Record description of support system and configuration for each major component and piping section.

Secondary Containment and Leak Detection System. Examine surface area of all accessible walls and floors of building and sumps for cracking, pitting, spalling, and conditions of coating. Also, examine the MCS room and instrumentation used for detecting leaks. Note areas of significant degradation or deformation. Photograph and record inspection results

6.1.1.2 Equipment

Equipment associated with visual inspection includes, but is not limited to cameras (film, digital, and video), remote cameras, fiberscopes, borescopes, magnifying glasses and mirrors. All equipment used for inspection shall be qualified to assure it meets the lighting and resolution requirements of ASME Section V, Article 9.

6.1.1.3 Qualifications of Inspectors

Inspections will be done by CH2M HILL or TGS designated Level II Quality Control (QC) inspectors.

The results of the visual walk down inspections will be evaluated, summarized and documented under the direction of the IQRPE and included as attachments to the IAR.

6.1.2 Level Draw Down Testing

In accordance with WAC 173-303-640(2)(c)(v), the leak test must be capable of taking into account the effects of temperature variations, tank end deflection, vapor pockets, and high water table effects and that addresses cracks, leaks, corrosion, and erosion. Level draw down leak testing of subsystems will be performed similar to leak testing performed in the previous two integrity assessments in 1993 and 1998 (HNF 2331 and HNF 2905). Level draw down testing under operational pressures or head will be applied to primary containment tanks and ancillary equipment. Established criteria is that a leak rate greater than 0.19 liters (0.05 gal per hour) is generally considered to be a "failed" test which indicates the tank system is not tight (Ecology 1994). However, in the case of the vapor-liquid separator, level instrumentation is sensitive to within +/- 2% of scale or the equivalent of 48 gallons. Therefore, acceptance criteria shall be "no detectable leaks," which would be demonstrable by a steady, non-reversed loss from the vapor-liquid separator system, or visual indication of leakage during the hold test. This criteria encompasses the aforementioned effects, as well as effects induced on measurement via instrument sensitivity. A detailed discussion of effects will be provided in the 2007 IAR. In addition to leak test measurement data, visual examination of components and secondary containment for leaks will be performed as part of the level draw down testing activities. Attachments B-1 and B-2 provide the list of major components affected by the draw down leak testing (indicated by the notation "Leak Test") and associated ancillary equipment (indicated by the notation " for the vapor-liquid separator subsystem and condensate collection subsystem respectively.

The 242-A Evaporator operating contractor will develop a leak test work package for evaluation and acceptance by the IQRPE prior to performing leak testing. The results of leak testing will be evaluated, summarized, and documented under the direction of the IQRPE for inclusion in the IAR.

The level draw down Leak Test report will include the following major sections:

- Section 1—Introduction
- Section 2—Qualified Personnel, Procedures, and Equipment
- Section 3—Leak Testing Components
- Section 4—Leak Testing Results
- Section 5—Conclusions
- Section 6—Integrity Assessment Certifications
- References

6.1.2.1 Level Draw Down Leak Testing Work Package

A work package shall be prepared prior to the actual testing and shall typically include the following major sections:

- Introduction
- Scope
- Qualified Personnel, Procedures, and Equipment
- Leak Testing Components
- Limitations of Leak Testing
- Leak Testing Procedures for Vapor-Liquid Separator Subsystem
- Leak testing Procedures for Condensate Collection Subsystem
- Test Apparatus
- Check List
- Quality Assurance and Safety
- Sequence of Activities and Schedule
- References

The components listed in Attachments B-1 and B-2 for the vapor-liquid separator subsystem and condensate collection subsystem respectively will be leak tested and the components listed in Attachment B-1 and B-2 will be visually inspected for evidence of leaks in accordance with the guidelines of ASME Section XI, Division 1, Class 3 (1989). IWA-5240 "Visual Examination" (VT-2). And IWD-5000 "System Pressure Tests Visual Examination Methods" (VT-2).

Leaks tests shall be performed at the appropriate hold points indicated in the 242-A Operational Test Procedures (Attachment B-4) for the Vapor-Liquid Separator subsystem and (Attachment B-5) for Condensate Collection Subsystem following the current Tank Farm Work Procedures to be obtained from CH2M Hill. The leak test shall encompass all major components of the Vapor-Liquid Separator Subsystem and Condensate Collection Subsystem that come in contact with the waste generated at the 242-A Evaporator TSD unit. These components include tanks, vessels, seams, pipes, flanges, and valves. Figure 6-1 shows a schematic of the Vapor-Liquid Separator Subsystem. Figure 6-2 shows a schematic of the Condensate Collection Subsystem.

The external portions of the components, piping, flanges, and valves will be examined for evidence of leaks during level draw down leak testing following the visual inspection plan described in Section 6.1.1.1. Much of the Vapor-Liquid Separator Subsystem components are covered with insulation. Because removal of the insulation would be time consuming and expensive, and would create excessive radiation exposure, the insulation will remain in place during the leak test inspection.

Visual examination shall be performed by a qualified inspector in accordance with ASME Section XI (VT-2) . For future reference, the areas examined are to be documented with photographs, results, and data sheets. Evidence of the QC Level II Inspector's qualification shall be available for review and included in the data package for the integrity assessment report.

Figures 6.1 and 6.2 can be used to assist in identifying locations and line numbers to be visually inspected during leak test.

Attachments B-4 and B-5 provide the leak test procedures for the Vapor-Liquid Separator Subsystem and Condensate Collection Subsystem Components.

6.1.2.2 Equipment

The following equipment is required for completing level draw down testing:

- Test Fluid (Water or Water with dye)
- Level Indicators (LIC-CA1-1 or LIC-CA1-2) for vapor-liquid separator
- Level Indicators (LI-C100-1 and LI-C100-2) for condensate collection tank

6.1.2.3 Qualifications of Inspectors

Testing personnel shall be qualified to the requirements of a nationally recognized Certification Program.

Figure 6. 1 Evaporator / Reboiler System Schematics For Hydraulic Leak Testing

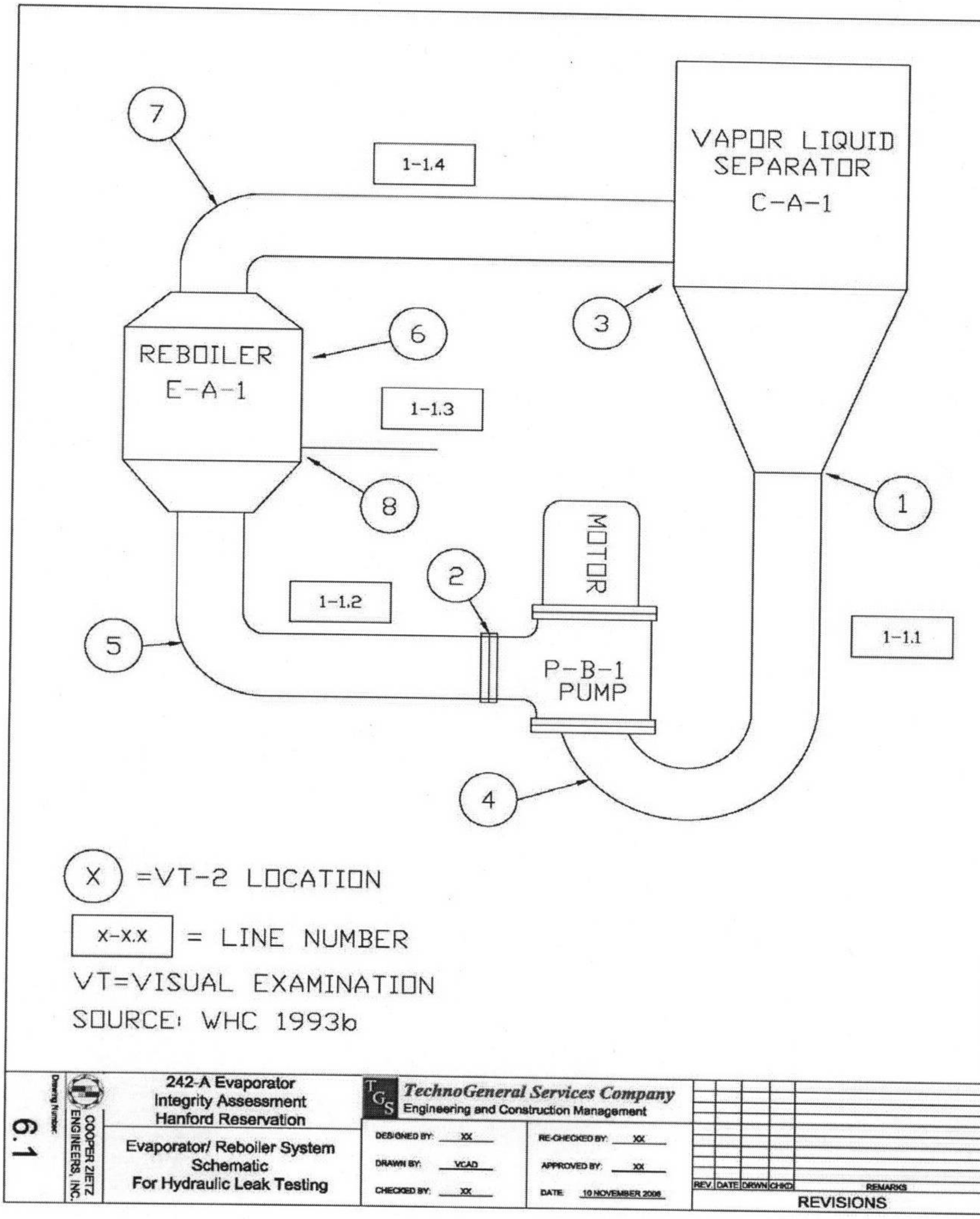
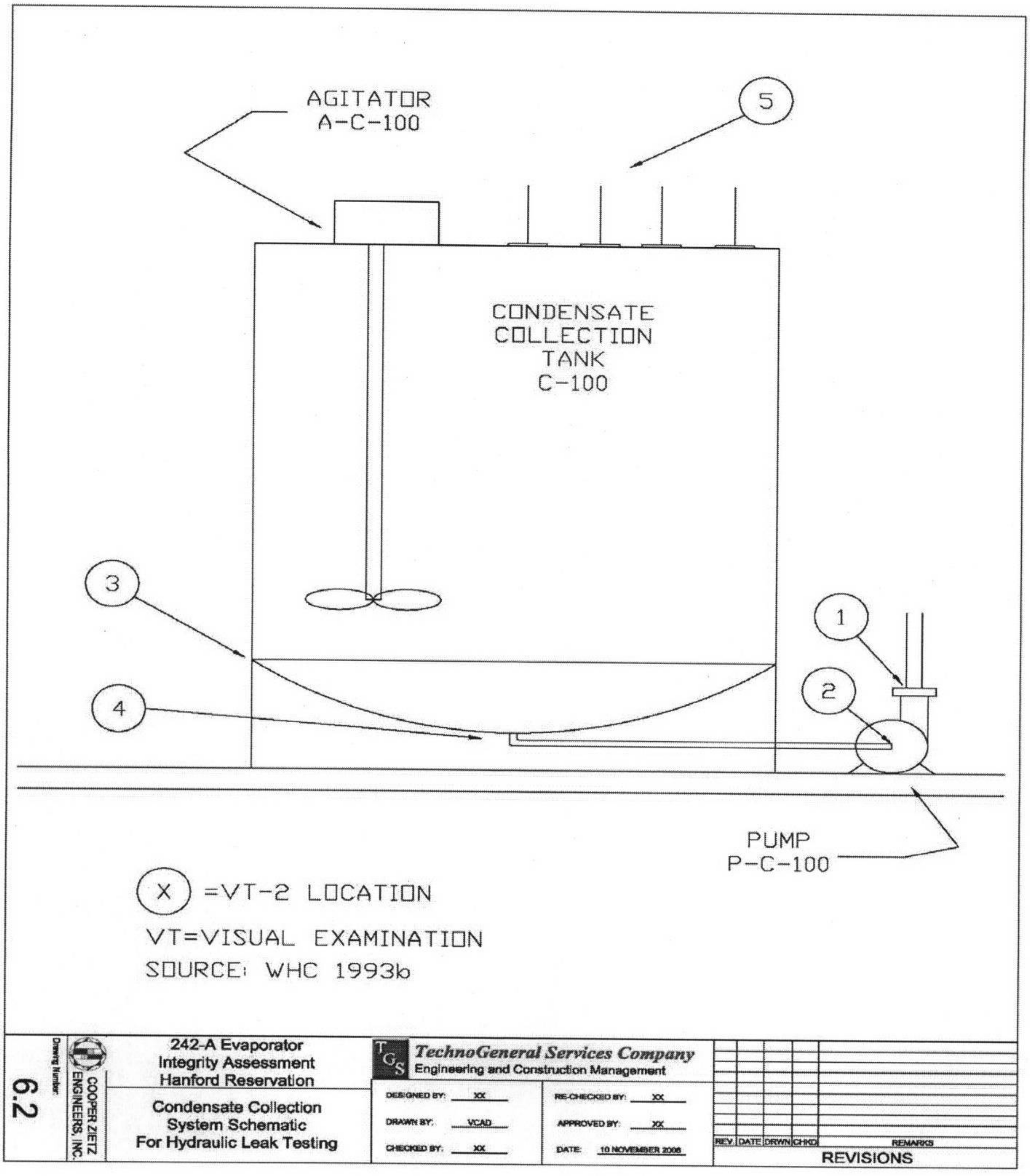


Figure 6. 2 Condensate Collection System Schematic for Hydraulic Leak Testing



6.1.4 Non-Destructive (Ultrasonic Testing [UT]) Examination

UT examination locations points are selected to assess locations of interest, usually where it has been determined increased wear, corrosion, or stress will occur. Key locations include flow transitions, such as bends, tees and reducers, areas where flow disturbance is possible, areas that may be subject to the accumulation of solids or scaling, as well as areas that may be subject to other mechanisms (such as vibration, pipe flexing, joints, welds, flanges, etc.) that may create opportunistic sites for defects to form.

Ultrasonic thickness testing (UTT) or thickness gauging is a manual operation which uses a small ultrasonic probe connected to a hand-held gauge. The main use of thickness gauging is to determine remaining wall thickness particularly in component areas where corrosion/erosion is suspected. For the assessment of component condition 'thickness surveys', as they are often referred to, are carried out. These are usually performed by making a number of 'spot' measurements with the thickness gauge in a grid pattern covering the component surface or the local area of concern. UTT is often performed on a grid that includes the complete circumference of the pipe or vessel in the area of interest.

There are four methods commonly used for determining Non-Destructive Examination (NDE) inspection of piping and vessels and can be used to calculate corrosion or wear in piping components from UT inspection data. These methods are band method, area method, moving blanket method, and point-to-point method. Three of the methods, which are the band, area and blanket methods, estimate the components initial thickness and can be used for evaluation of components with single inspection data. Further, wear or corrosion rates over longer periods can be calculated by using subsequent inspection data. These three methods are effective because the wear caused by wear or corrosion are typically found in a localized area or region. The point-to-point method can be used when data taken at the same grid locations exists from two or more inspection cycles (or baseline data plus data from one or more outages). In such cases, it is possible to obtain a difference in thickness readings for each grid inspection. The wear or corrosion rate at each grid location is the thickness taken at the earlier inspection minus the thickness taken at the later inspection in accordance with ASME Code. The largest of the grid wear values is the component maximum wear between the two outages. The point-to-point method does not estimate the initial component thickness.

Band, area, and blanket methods are methods of calculating wear rates by taking either a band, area, or blanket from around the circumference of the pipe or vessel and subtracting the minimum wall thickness reading in the region from the maximum wall thickness reading in the region.

The point to point method is a method of calculating corrosion or wear rates by subtracting the measurement taken at a grid point during the current outage from the measurement taken at the same grid point during the previous outage.

When employing any of the aforementioned NDE inspection methods, grid patterns or inspection area layout instructions should be documented clearly, for example with drawings and/or inscribed permanently directly on the parts inspected to allow repeatability and correlation of inspection data for subsequent NDEs. This allows for reliability in the calculation of wear and corrosion rates.

It may occur that points that have been either previously selected are inaccessible or become inaccessible because of equipment changes, changes to operations, or safety concerns. Should this occur, testing at these locations may be abandoned provided that:

1) Sufficient data are collected from a sufficient number of points to make a meaningful statistical analysis of the integrity of areas examined or to determine the existence of flaws or other conditions leading to corrosion, thinning, cracking, wear, or other flaws
2) Grid patterns or other inspection area layout instructions are used and documented clearly, for example with a sketch and/or marking directly on the area of concern, to allow repeatability and correlation of inspection data for subsequent examinations.;
3) Any changes or alterations are clearly documented such that any changes to NDE protocols may be easily employed in the field as well as repeated in future NDE events; and
4) Sufficient data is collected to detect flaws (if present), determine thickness, wear, and corrosion rates.

In 1993, UT thickness data was collected at a total of 2,636 test points at 17 test locations (20 if sub locations such as 9A, 9B, and 8A are included in the total). Of these points, 1,342 were in the Evaporator Room and 1,294 were in the Condenser Room. In 1998, a total of 1,370 test points at 12 locations were evaluated. Of these, 184 were in the Evaporator Room and 1,186 were in the Condenser Room. Appendix E of the 1998 IAR indicated that 7 locations were not evaluated (1, 2S, 2T, 4, 6, 10, and 14), not including in the total locations 8 and 8A, which evaluated the "old" E-C-1, and including 2S and 2T as separate test locations. In addition, multiple test points were not accessible. The 1998 IAR recommended that the next IAP include all accessible equipment and grid points that were tested in 1993 so that a more extensive evaluation of corrosion rates could be completed and a more exhaustive assessment of remaining equipment life could be established. The number of test points for the 2007 Integrity Assessment has been established at a total of 2,042 test points at 18 locations after reviewing ALARA radiation concerns with the TSD unit, as well as eliminating points that were not accessible in the 1998 IAR. Of these locations, 945 UT points are in the Evaporator Room and 1,107 UT points are in the Condenser Room. Table 6.1 provides a summary of the UT points and their locations. Figures 6.3 through 6.20 provide detailed location information and data collection sheets for the UT testing process.

To reduce time spent in high radiation areas, the number of test bands were reduced in Locations 1, 2, and 4. In all previous integrity assessments of the 242-A evaporator, 2-inch grids were selected to evaluate evaporator, condenser, and components. In engineering judgment, repeatability criteria would be best satisfied by reducing test points via reducing the number of UT thickness testing bands within a test area while retaining 2-inch grids wherever possible. Other test point reduction strategies, such as eliminating every other point would not retain 2-inch grids, may be difficult to implement reliably in the field, especially when testers are inhibited by bulky health and safety equipment, and further, if it is desired to evaluate additional areas in future IAPs, it is more difficult to determine what areas have not been evaluated in previous IARs. As described above, wear rates may be calculated taking band of data points around the circumference of a pipe or vessel and subtracting the minimum wall thickness reading in the region from the maximum wall thickness reading in the region. In this way, UT test locations were reduced from areas to bands, however, to best satisfy repeatability criteria, 2-inch grids were retained within these bands.

Evaporator system locations

Locations 1 and 2, (Figure 6.3 and Figure 6.4) are located on the 42-inch vapor line above the evaporator. The line is 5/16-inch stainless steel and carries away vapors from the evaporator to the vacuum condenser system. Corrosion or wear at this location would most likely be the result of condensation; however, and other pitting and other non-uniform defects, including scaling may also occur at unpredictable locations. The locations are hard to access for UT inspection; also, they are located in ALARA concern areas. The 1993 IAR evaluated 260 UT points at Location 1 and 245 UT points at Location 2. No evaluation was done in 1998 IAR for Locations 1 and 2. At Location 1, testing was retained in circumferential bands in order to calculate thickness and wear but was reduced to bands A and D, corresponding to the inner and outer areas of the test location. Test points were retained in 2-inch grids and around the circumference of the 42-inch vapor line, reducing the number of points to 65 points per band. The 1993 data indicates little variability between measurements. The total of 130 points exceed the minimum of 5 points that should be taken per sample group (ASTM 2005 and Health and Safety Executive [HSE] 2002); and the area to be tested covers the area of concern. Therefore, this number of test points should provide sufficient data to evaluate this section of the vapor line. Subsequent IAPs, to satisfy repeatability criteria, should consider these test points as a new baseline for testing this location.

At Location 2, (Figure 6.4) areas corresponding to bands A, D, and G were retained, corresponding to the outer areas and centerline of the area of concern, retaining the 2-inch grids. 19 data points for each of these columns in test region S and 16 data points for each of these columns in test region T reduced the number of test points to 105 from 245 based on ALARA concern and accessibility problems, while still taking more measurements than required for statistical analysis (ASTM 2005 and HSE 2002). This will provide sufficient test data over the area of concern to evaluate these areas, retaining the ability to calculate corrosion and wear in this area, while reducing the number of data points. Evaluation of these test points at Locations 1 and 2 should allow sufficient evaluation of the 42-inch vapor line in the areas examined. However, if defects are discovered at the test points evaluated, additional testing may be recommended. Subsequent IAPs, to satisfy repeatability criteria, should consider these test points as a new baseline for testing this location.

Location 3, (Figure 6.5) is the shell of the C-A-1 evaporator, centered at the vapor / condensate level. The shell is 3/8-inch thick stainless steel. This location offers an opportunistic location for corrosion and defects because the two phase interface location, including pitting and scaling.

In 1993, 456 data points were collected over the entire area (A-L, 1-38). In 1998, only a portion of this area was accessible (A-L, 1-6). It was proposed to repeat testing in this area since this area was believed to remain accessible for testing. It has since been found that 50 feet of scaffolding are required to re-test the 1998 area. However, an area at the same elevation is available on C-A-1. If the original location is no longer accessible, it is acceptable to test a new area if an old area becomes inaccessible.

References indicate that a minimum of 5 test points may be utilized for extreme value distribution analyses (ASTM 2004, ASTM 2005 and Health and Safety Executive [HSE] 2002), however, as a practical matter, predicting the probability of the minimum measurement becomes impractical if the area tested is much less than the total surface area of the equipment evaluated. This is both a function of the range of measurements as well as the ratio between area tested and total surface area.

In the case of Location 3, the most defensible testing strategy is to first satisfy the criteria of repeatability. If this cannot be done, than collecting more data to obtain a more statistically stable data set would be the next most defensible action. In evaluating previously collected data from previous IARs, good probability predictions may be obtained from thickness data if thickness data is collected from at least 0.5 to 1 percent of the surface area. This corresponds to testing a minimum of 336 points and up to 660 points (456 were tested in 1993).

The 1998 IAP has a table that specifies a grid of 12 x 40 points with the grid centered on the 721'-2" level (the normal operating liquid level of the vessel). Equal UT data points would be obtained above and below the normal operating level. The vertical lines of the grid should be spaced at 2" intervals and the horizontal lines of the grid should be spaced at 2" intervals. The grid pattern of 480 UT data points should be obtained at the 721'-2" vessel level from the most accessible location on the right side of the recirculation line connection to the vessel.. This will require that CH2M Hill Hanford identify the C-A-1 vessel location (a plan sketch should be provided) where the UT data will be obtained.

Location 4, (Figure 6.19), evaluates the bottom of the mitered elbow of the 28-inch recirculation line between C-A-1 and P-B-1. The 28-inch line is ¼-inch thick stainless steel and contains a mixture of waste slurry, RW and FRW. The 1993 IAR evaluated 112 test points in four 2-inch test grids (Data S, T, U and V) at Location 4. ALARA concerns exist at Location 4. In addition, the location is expected to experience wear from contact from the working fluid of the system, is a location of velocity, and pressure change, as well as a low point in the system overall. Provided that sufficient data may be collected over the area of concern, the number of data points may be reduced. The sample grids for test Location 4 area above this minimum and a reduction could be achieved if safety concerns are sufficiently high. An examination of previously collected UT data indicates little variability both within this test section and at other locations on the 28-inch line. The current IAP recommends retesting the exiting test grid, but reducing testing to the central two bands in each test grid (bands C and D) (28 UT points).

Location 5, (Figure 6.6) evaluates the mitered elbow of the 28-inch recirculation line between E-A-1 and P-B-1. The 28-inch line is ¼-inch thick stainless steel and contains a mixture of waste slurry, RW and FRW. Each IAR conducted to date (1993 and 1998) evaluated 52 test points in two 2-inch test grids (Data S and Data T) at Location 5. ALARA concerns exist at Location 5. Provided that sufficient data may be collected over the area of concern, the number of data points may be reduced. The sample grids for test Location 5 area above this minimum and a reduction could be achieved if safety concerns are sufficiently high. However, the total data points, while higher than those required for statistical analysis, are also lower than at most other locations. Further, the location is expected to experience wear from contact from the working fluid of the system, is a location of velocity, and pressure change, as well as a low point in the system overall. Finally, there are no accessibility problems indicated for this location. The current IAP recommends retesting the existing test grid, replicating the total number of UT points in the existing grid (52 UT points).

Location 6 (Figure 6.20) evaluates the upper and lower conical sections of the Reboiler (E-A-1). These sections are subject to flow and velocity changes in the working fluid. Test Location 6 was evaluated in 1993 but not in 1998. The 1993 evaluated 28 UT points each on the upper and lower conical sections on face of the Reboiler opposite the 16-inch steam line. ALARA concerns exist at Location 6. Provided that sufficient data may be collected over the area of concern, the number of data points may be reduced. The sample grids for test Location 6 area are above this minimum and a reduction could be achieved if safety concerns are sufficiently high. However, the total data points, while higher than those required for statistical analysis, are also lower than at most other locations. Further, the location is expected to experience wear from contact from the working fluid of the system and is a location of velocity, and pressure change. In addition, the component E-A-1 has experienced steam pulses. While UT measurements will not measure these effects directly, it will provide another method of assessing the integrity of this process component..

Location 7, (Figure 6.7) evaluates the outer side of the mitered elbow of the 28-inch recirculation line between the C-A-1 evaporator and the E-A-1 reboiler. As previously stated, the 28-inch line is ¼-inch stainless steel, and is in contact with a mixture of waste slurry, RW, and FRW. The location is a two phase interface location as well as a directional change and pressure change location. This location is in an ALARA concern area and has accessibility problems. In 1993, 112 points were evaluated at Location 7. In 1998, 48 points were evaluated (Data V and part of Data U, excluding Data S and Data T). In this location, test grids Data U and V are located above the vapor condensate operating line and test grids Data T and S are below it. It was determined prior to the 2007 IA that test grids 7T and 7U are no longer accessible. After reviewing site conditions and concerns, 1993 and 1998 data, and determining that little variability in thickness measurements at previous grids exists at this location, it was determined that test points could be reduced to 56 total points. This would be accomplished by eliminating testing at the inaccessible test locations 7T and 7U. However, to maintain a statistically significant data set, it is recommended that a grid of 4 x 11 UT data points for location 7U and a grid of 4 x 3 data points for location 7V be obtained. The vertical lines of the grid should be spaced at 2" intervals and the horizontal lines of the grid should be spaced at 2" intervals. Recommendations for statistical data are satisfied for the area of concern to be evaluated (ASTM 2005 and HSE 2002). Therefore, evaluation of these test points at Location 7 should allow sufficient evaluation of the 28-inch vapor line elbow. However, if defects are discovered at the test points evaluated, additional testing may be recommended.

Location 15, (Figure 6.12) evaluates the slurry drain line from the 28-inch recirculation line. The line is 0.134-inch stainless steel and is in contact with waste slurry. The line is in located in an ALARA concern area. However, no access problems are indicated for the test location. The line is stainless steel in direct contact with concentrated waste slurry.

Location 18, (Figure 6.15) evaluates the bottom of the 28-inch recirculation line along the mitered elbow to Valve HV CA1-7 between C-A-1 and P-B-1. As previously stated, the 28-inch line is ¼-inch stainless steel, and is in contact with a mixture of waste slurry, RW, and FRW. The location has been added in the current IAP (2007) and was not previously evaluated in the 1993 or 1998 IARs. It is proposed to evaluate 28 UT points in a 2-inch grid along the mitered elbow. The location is in an ALARA concern area, however, no accessibility problems are indicated. Applicable guidance documentation (ASTM 2005 and HSE 2002) recommends evaluating at least 5 points for statistical data analysis. Testing at this location exceeds the number of minimum points required, however, the line is in direct contact with concentrated waste slurry. In addition, the location is at a low point in the evaporator system; represents a direction change, as well as a pressure drop in the system.

Condenser Room Locations

Location 9, (Figure 6.8A and Figure 6.8B) evaluates the E-C-1 primary condenser shell. The E-C-1 shell is constructed of ½-inch carbon steel and is in contact with process condensate and vapor. The 1993 IAR evaluated 603 data points at Location 9. The 1998 evaluated 616 data points. The current IAP (2007) proposes to evaluate 484 data points. No ALARA or accessibility concerns are indicated at this location. The E-C-1 shell is not in contact with concentrated process waste, however, the shell is constructed of carbon steel, which should warrant closer monitoring than a superior material under similar conditions.

Location 11, (Figure 6.9) evaluates the TK-C-100 tank shell. The tank is constructed of 5/16-inch 347 and 304L stainless steel. The tank is in contact with process condensate and is not in contact with concentrated process waste. No ALARA or accessibility concerns are indicated at this location. The 1993 and 1998 IARs evaluated 432 points at Location 11. The current IAP (2007) proposes to evaluate 432 points. However, the tank represents both a lowpoint and endpoint of the condensate collection system

Location 12, (Figure 6.10) evaluates the E-C-2 inter condenser shell. The E-C-2 shell is constructed of 5/16-inch carbon steel in contact with process condensate and vapor. The 1993 and 1998 evaluated a similar number of UT points (72 and 75 points, respectively). The current IAP (2007) recommends evaluating 75 UT points. No ALARA or accessibility concerns are indicated at this location. The E-C-2 shell is not in contact with concentrated process waste, however, the shell is constructed of carbon steel, which should warrant closer monitoring than a superior material under similar conditions. This vessel was replaced after the 1998 IAR so it is recommended to establish a new baseline with the same number of UT data points, in a 2-inch grid pattern, that were evaluated in 1998.

Location 13, (Figure 6.11) evaluates the E-C-3 after condenser shell. The E-C-3 shell is constructed of 5/16-inch carbon steel in contact with process condensate and vapor. The 1993 and 1998 evaluated 39 UT points in a 2-inch grid. The currently IAP (2007) also recommends evaluating 39 UT points in a 2-inch grid. No ALARA or accessibility concerns are indicated at this location. The E-C-2 shell is not in contact with concentrated process waste, however, the shell is constructed of carbon steel, which should warrant closer monitoring than a superior material under similar conditions. Further, the number of UT points per circumferential band is not much higher than the minimum recommended by ASTM for statistical analysis. This vessel was replaced after the 1998 IAR so it is recommended to establish a new baseline with the same number of UT data points, in a 2-inch grid pattern, that were evaluated in 1998.

Location 16, (Figure 6.13) evaluates the C-100 drain line to the LERF (3"DR-359-M42). The line is 0.216-inch carbon steel. The line drains process condensate from tank C-100. The 1993 and 1998 IARs evaluated 12 UT points in a 2-inch grid. The current IAP (2007) also recommends evaluating 12 UT points in a 2-inch grid. No ALARA or accessibility concerns are indicated at this location. The drain line is not in contact with concentrated process waste, however, the line is constructed of carbon steel, which should warrant closer monitoring than a superior material under similar conditions. Further, the number of UT points per grid is not much higher than the minimum recommended by ASTM for statistical analysis.

Location 17, (Figure 6.14) evaluates the 6-inch vapor line between E-C-1 and E-C-2 (6" VAC-M42). The line is constructed of 0.280-inch carbon steel. The line is in contact with process condensate and vapor. The 1993 and 1998 IARs evaluated 12 UT points in a 2-inch grid. The current IAP (2007) also recommends evaluating 12 UT points in a 2-inch grid. No ALARA or accessibility concerns are indicated at this location. The vapor line is not in contact with concentrated process waste, however, the line is constructed of carbon steel, which should warrant closer monitoring than a superior material under similar conditions.

Location 19, (Figure 6.16) evaluates the F-C-1 Filter wall thickness. This filter is constructed of welded carbon steel.

Location 21, (Figure 6.17) evaluates the F-C-3 Filter wall thickness. This filter is constructed of cast iron. No prior UT readings were taken during the 1998 integrity assessment.

Location 22, (Figure 6.18) evaluates the pipeline exiting from the TK-C-100 tank downstream of the condensate pump P-100.

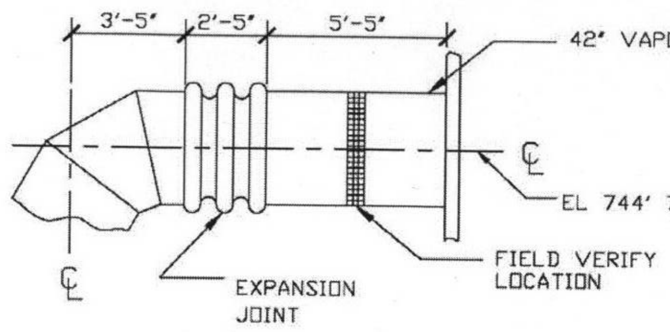
Table 6. 1 UT Locations and Equipment

LOCATION	COMPONENT TO BE UT TESTED	LOCATION OF UT GRID	DESCRIPTION OF UT GRID
1 (Figure 6.3)	42" Recirculation (Vapor) Line (5/16" thick SS)	42" Dia Evaporator Line Downstream of Expansion Joint	6" Wide x 42" Dia, 2" square grid, bands A and D only.
2 (Figure 6.4)	42" Vapor Line (5/16" thick SS)	Mitered Elbow on 42" Evaporator Line Upstream of Expansion Joint	6" Wide x 42" Dia, 2" grid at locations T and S; bands A, D, and G only.
3 (Figure 6.5)	C-A-1 Evaporator Shell (3/8" thick. SS)	Horizontal grid band on the Evaporator vessel, centered over the vapor/condensate level.	New band 24" x 80" Dia , 2" square grid.
4 (Figure 6.19)	28" Recircirculation Line Elbow (1/4" thick. SS)	On mitered elbow located on 28" Diameter Recirc. Line below C-A-1 inlelt to P-B-1.	4" wide along bottom of radius portion of elbow and extending 6" beyond the ends of the elbow at Data S and V.
5 (Figure 6.6)	28" Recircirculation Line Elbow (1/4" thick. SS)	On mitered elbow located on 28" Diameter Recirc. Line below E-A-1 discharge from P-B-1.	6" wide along outside radius portion of elbow, and extending 3" beyond the upper ends of elbow including welded joints, 2" square grid at locations S and T.
6 (Figure 6.20)	E-A-1 Reboiler Shell (1/4" thick SS)	On upper and lower conical transitions located on face opposite of 16-inch steam line	8" by 14" grid on each conical transition

LOCATION	COMPONENT TO BE UT TESTED	LOCATION OF UT GRID	DESCRIPTION OF UT GRID
7 (Figure 6.7)	28" Recirculation Line (1/4" thick.SS); testing side against wall	Grid location is along the length of mitered elbow on outside radius, to extend 3" on each side of last weld joint	6" wide along mitered elbow, 2" square grid, at locations S, T, U, and V; bands A and D only.
9AA, 9A, 9BB, and 9B (Figure 6.8A & Figure 6.8B)	E-C-1 Primary Condenser (1/2" thick. CS)	Individual wall thickness measured along one length and one diameter between end flanges.	4 locations, 2" square grid.
11 (Figure 6.9)	Condensate Collection Tank (5/16" thick. SS)	Wall thickness of tank measured on side of tank approximately one-third of the distance up from bottom on the tank on the outlet side of the tank.	24". (vertical) x 72" Dia., band, 2" square grid.
12 (Figure 6.10)	E-C-2 Intercondenser (5/16" thick. CS)	Individual wall thickness measured around circumference of condenser.	6" wide band x 50" (360°), 2" square grid.
13 (Figure 6.11)	E-C-3 Aftercondenser (0.332" thick. CS)	Individual wall thickness measured around circumference of condenser.	6" wide band x 26" (360°), 2" square grid.
15 (Figure 6.12)	Slurry Drain Line to 241-AW Tank Farm (6" DR-335-M9) (0.134" thick. SS)	6 individual wall thickness measurements along pipe.	2" x 24" band beginning downstream from the first exit elbow on the slurry return line toward the 241-AW Tank Farm, 2" square grid.

LOCATION	COMPONENT TO BE UT TESTED	LOCATION OF UT GRID	DESCRIPTION OF UT GRID
16 (Figure 6.13)	TK-C-100 to 241-AW drain line (3" DR-359-M42) (0.216 thick. CS)	6 individual wall thickness measurements along pipe.	2" x 24" band beginning outward from the TK-C-100 Tank toward LERF, 2" square grid.
17 (Figure 6.14)	E-C-1 to E-C-2 Line (6" VAC-1500-M42) (0.280" thick. CS)	Minimum 12 individual wall thickness measurements along pipe.	2" x 24" band on the process condensate connecting line between E-C-1 to E-C-2, 2" square grid.
18 (Figure 6.15)	28" Recirculation Line from C-A-1 inlet to P-B-1 inlet at valve HV-CA1-7	Mitered Elbow (bottom) on 28" Recirculation Line, Downstream of E-A-1 Inlet. Located in Evaporator Room	2" x 56 band with 11 individual readings at locations T and U and 3 individual readings at locations S and V, 2" square grid.
19 (Figure 6.16)	Condensate Filter, F-C-1	Minimum 12 individual wall thickness measurements around the circumference of the condensate filters	A horizontal band 2" wide x 24" Dia. centered at the shell, 2" square grid.
21A and 21B (Figure 6.17)	Condensate Filter, F-C-3	Minimum 12 individual wall thickness measurements around the circumference of the condensate filters	Two horizontal bands 2" wide x 16" Dia. centered at the shell, 2" square grid.
22 (Figure 6.18)	Condensate recirculation line, (2" CS, PC-554-M42)	Minimum 12 individual wall thickness measurements	A 2" x 24" band along the length of line, 2" square grid.

* UT Location numbers are those that were used in the 1993 and 1998 IARs Along with new locations.



SCALE: 1:40

COMPONENT: 42" VAPOR LINE (5/16" Thk SS)
DESCRIPTION: 42" EVAPORATOR LINE DOWNSTREAM OF EXPANSION JOINT
GRID: 6" WIDE X 42" DIA 2" GRID

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

SOURCE: WHC 1993b
DRAWING H-2-69340, SH -OF-, REV 3 (USDOE 1977)

	A	B	C	D		A	B	C	D		A	B	C	D		A	B	C	D
1					17					33					49				
2					18					34					50				
3					19					35					51				
4					20					36					52				
5					21					37					53				
6					22					38					54				
7					23					39					55				
8					24					40					56				
9					25					41					57				
10					26					42					58				
11					27					43					59				
12					28					44					60				
13					29					45					61				
14					30					46					62				
15					31					47					63				
16					32					48					64				
															65				

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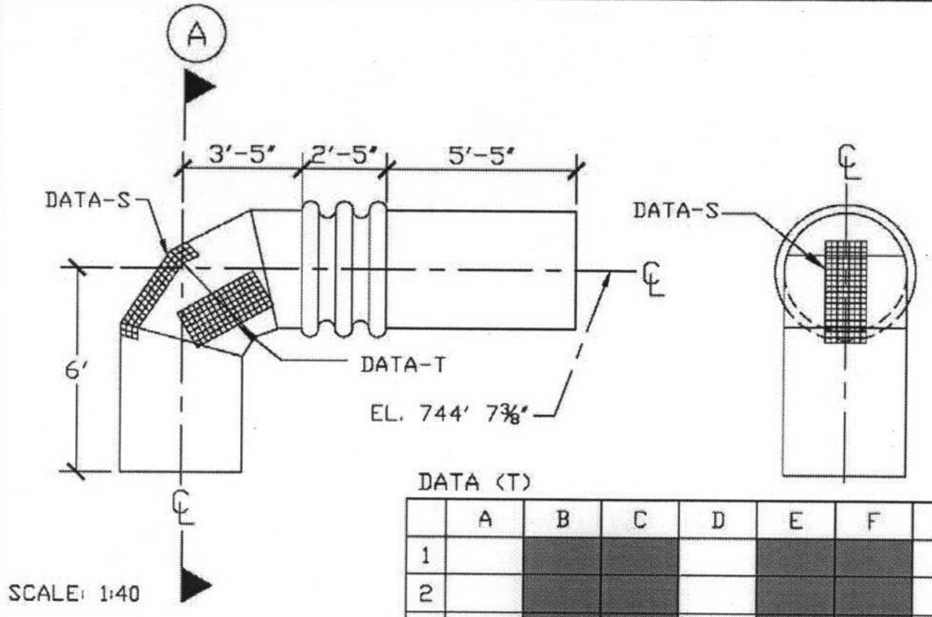
LOCATION 1, 42" VAPOR LINE
Downstream of
Expansion Joint

COOPER ZIETZ ENGINEERS, INC

6.3

Figure 6. 3 Location 1, 42" Vapor Line, Downstream of Expansion Joint



COMPONENT: 42" VAPOR LINE (5/16" Thk SS)
DESCRIPTION: MITERED ELBOW ON 42" EVAPORATOR LINE UPSTREAM OF EXPANSION
GRID: 2" GRID

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

SOURCE: WHC 1993b
DRAWING H-2-69340, SH -OF-, REV 3 (USDOE 1977)

DATA (T)

	A	B	C	D	E	F	G
1							
2							
3							
4							
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6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							

DATA (S)

	A	B	C	D	E	F	G
1							
2							
3							
4							
5							
6							
7							
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11							
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16							
17							
18							
19							

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LOCATION 2, 42" VAPOR LINE

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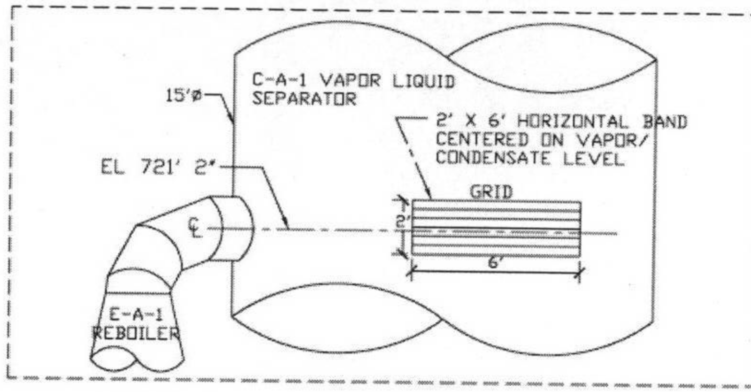
6.4

Figure 6. 4 Location 2, 42" Vapor Line

Figure 6. 5 Location 3, C-A-1 Evaporator



SCALE: 1:50

	1	2	3	4	5	6
A						
B						
C						
D						
E						
F						
G						
H						
I						
J						
K						
L						

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A														
B														
C														
D														
E														
F														
G														
H														
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J														
K														
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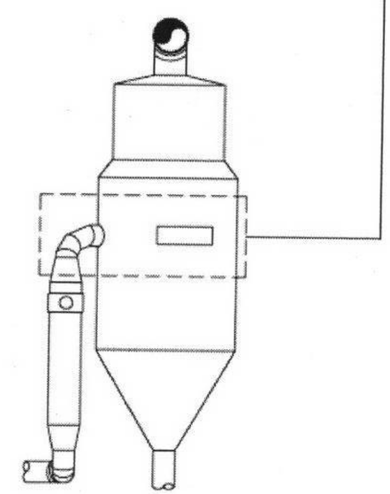

SOURCE: WHC 1998b
DRAWING H-2-69340,
SH -OF-, REV 3
(USDOE 1977)

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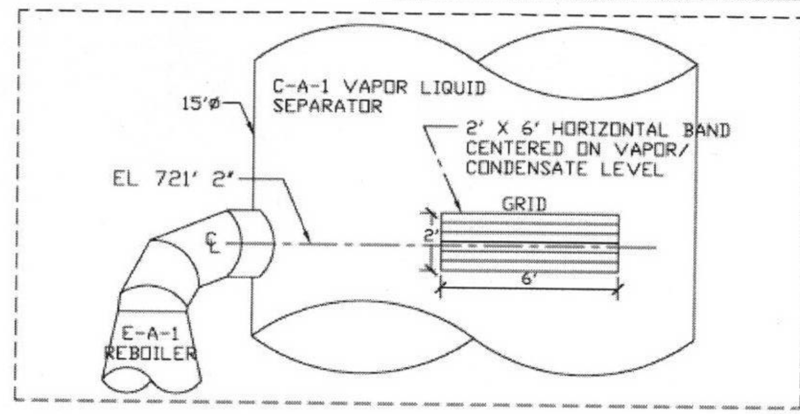
LOCATION 3
C-A-1 EVAPORATOR

COOPER ZIETZ ENGINEERS, INC.

Drawing Number
6.5A

(2nd page of revised figure 6.5)

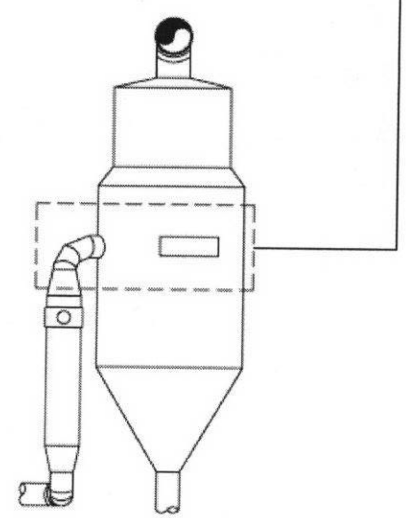
	21	22	23	24	25	26
A						
B						
C						
D						
E						
F						
G						
H						
I						
J						
K						
L						



SCALE: 1:50

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

	27	28	29	30	31	32	33	34	35	36	37	38	39	40
A														
B														
C														
D														
E														
F														
G														
H														
I														
J														
K														
L														



SOURCE: WHC 1998b
DRAWING H-2-69340,
SH -OF-, REV 3
(USDOE 1977)

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LOCATION 3
C-A-1 EVAPORATOR

COOPER ZIETZ ENGINEERS, INC.

6.5B

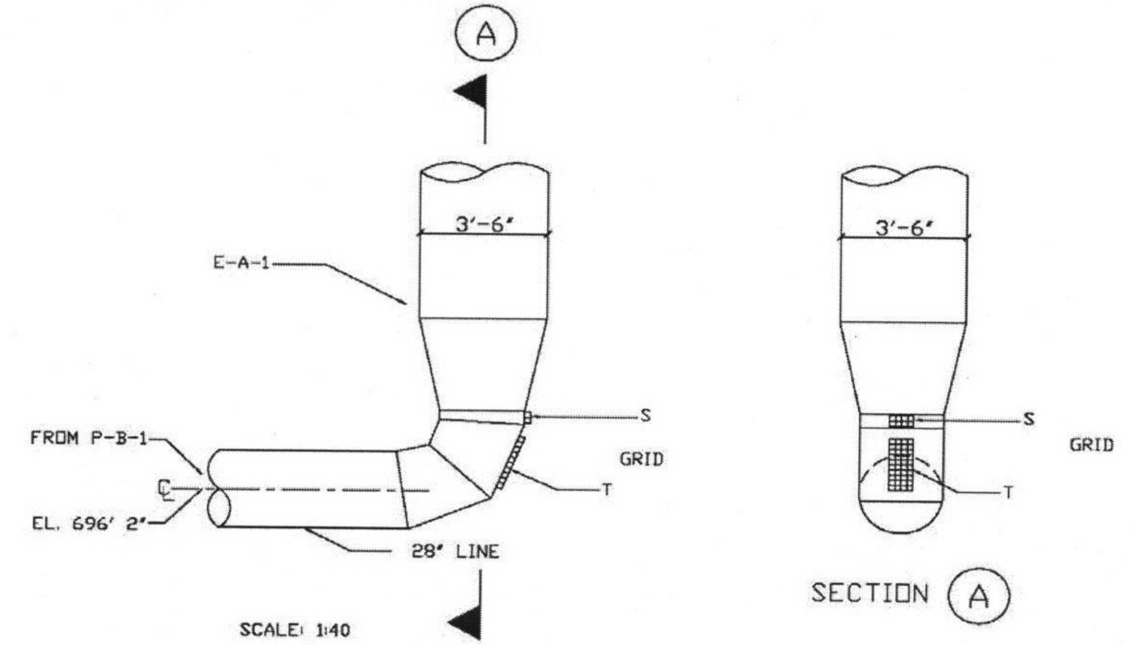
Figure 6. 6 Location 5, 28" Recirculation Line

DATA (S)

	A	B	C	D
1				
2				
3				

DATA (T)

	A	B	C	D
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				



NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON 'AS BUILT' ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

SOURCE: WHC 1993b
DRAWING H-2-69340, SH -OF-, REV 3 (USDOE 1977)

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LOCATION 5
28"RECIRC LINE

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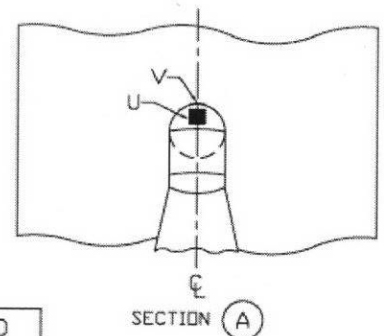
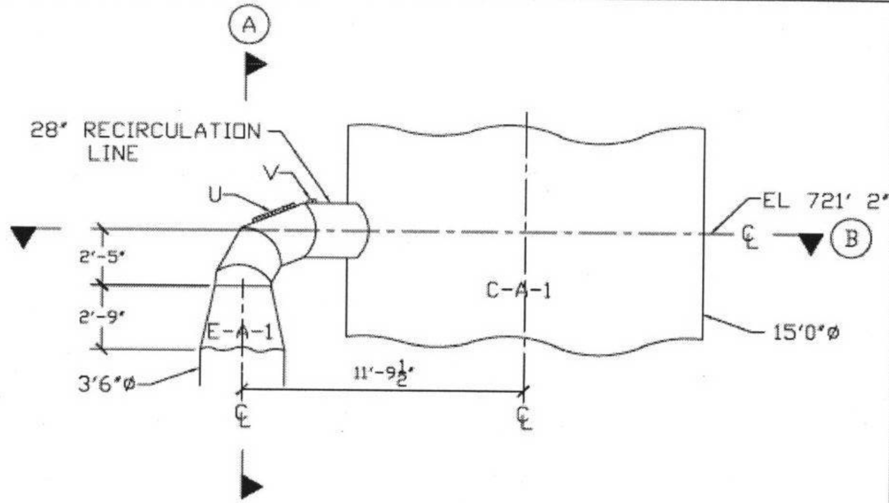
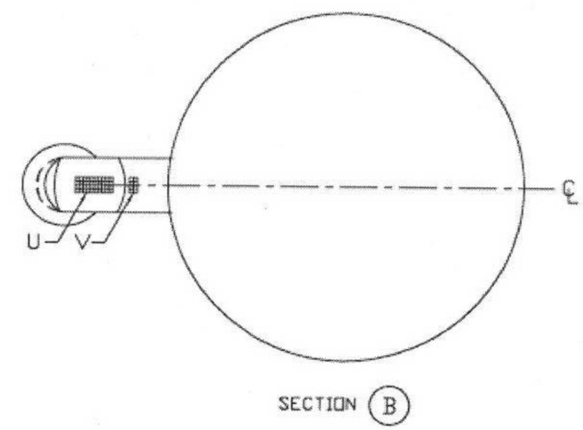
6.6

Figure 6. 7 Location 7, 28" Recirculation Line







DATA (U)

	A	B	C	D
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				

DATA (V)

	A	B	C	D
1				
2				
3				

COMPONENT: LINE 1-1.4 (¼" Thk SS)
DESCRIPTION: 6" WIDE ALONG LENGTH OF MITERED ELBOW, TO EXTEND 2" ON EACH SIDE
GRID: 2" GRID

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

SOURCE: LMHC 1998b
DRAWING H-2-69340, SH -OF-, REV 3 (USDOE 1977) AND H-2-99029, SH 1 OF 1, REV 2 (USDOE 1989)

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LOCATION 7
28" RECIRC LINE

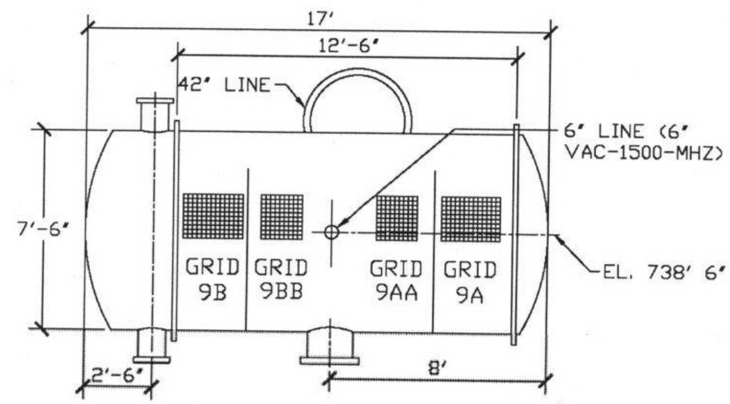
COOPER ZIETZ ENGINEERS, INC.

Drawing Number 6.7

Figure 6. 8A Location 9A & 9AA, E-C-1 Primary Condenser

GRID 9AA

	A	B	C	D	E	F	G	H	I
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									



SCALE: 1:50

E-C-1 PRIMARY CONDENSER

GRID 9A

	A	B	C	D	E	F	G	H	I	J	K	L	M
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

SOURCE: LMHC 1998b
DRAWING H-2-99034, SH 1 OF 1, REV 2 (USDOE 1989)

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E-C-1 PRIMARY CONDENSER LOCATION 9A, 9 AND 9B

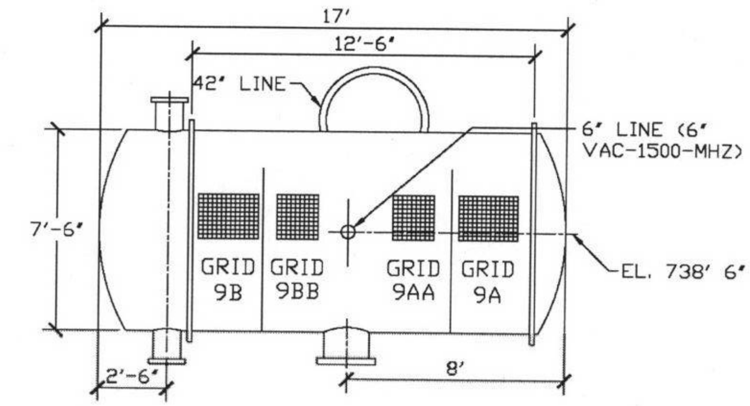
COOPER ZIETZ ENGINEERS, INC

6.8A

Figure 6.8B Location 9B & 9BB, E-C-1 Primary Condenser

GRID 9BB

	A	B	C	D	E	F	G	H	I
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									



SCALE: 1:50

E-C-1 PRIMARY CONDENSER

GRID 9B

	A	B	C	D	E	F	G	H	I	J	K	L	M
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

SOURCE: LMHC 1998b
DRAWING H-2-99034, SH 1 OF 1,
REV 2 (USDOE 1989)

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E-C-1 PRIMARY CONDENSER
LOCATION 9A, 9
AND 9B

COOPER ZIETZ ENGINEERS, INC.

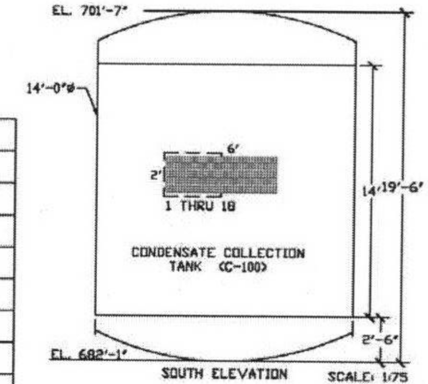
Drawing Number
6.8B

Figure 6. 9 Location 11, TK-C-100 Condensate Collection Tank

PREVIOUS TEST LOCATION IS UNKNOWN. TEST LOCATION SELECTED IS THE SOUTH SIDE OF TK-C-100. ACCESSIBLITY OF THE TEST LOCATION TO BE FIELD VERIFIED.

SOURCE: WHC 1993b
DRAWING H-2-69357, SH - OF -, REV 2 (USDOE 1976)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A																		
B																		
C																		
D																		
E																		
F																		
G																		
H																		
I																		
J																		
K																		
L																		



	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
A																		
B																		
C																		
D																		
E																		
F																		
G																		
H																		
I																		
J																		
K																		
L																		

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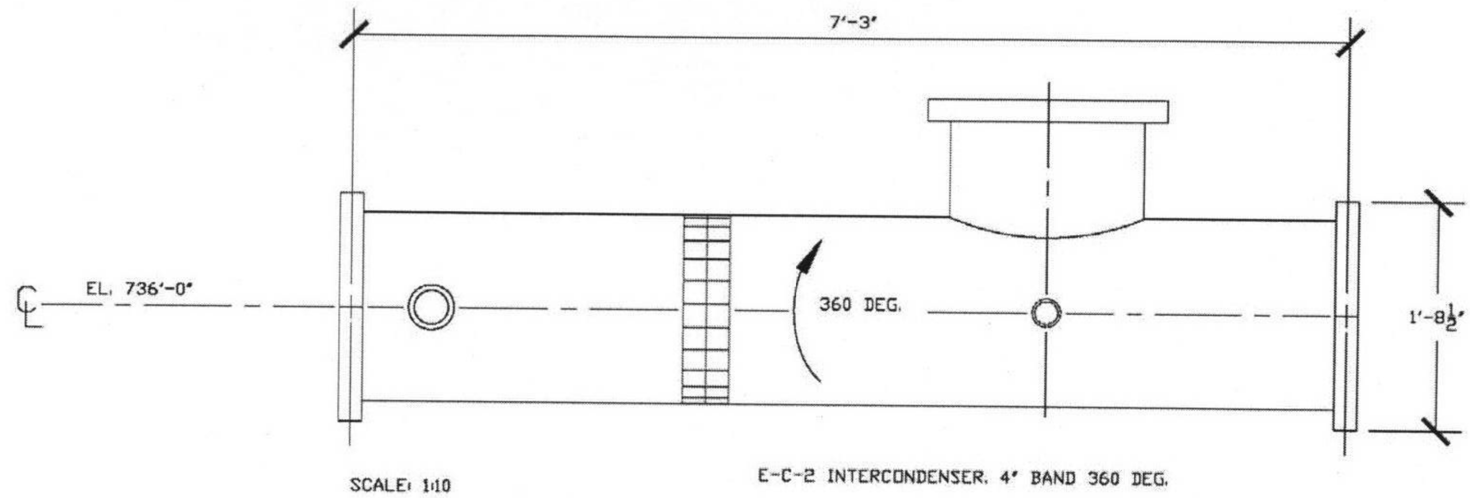
C-100 CONDENSATE
COLLECTION TANK
LOCATION 11

COOPER ZIETZ ENGINEERS, INC.

6.9

Figure 6. 10 Location 12, Intercondenser E-C-2



NOTE: E-C-2 Covered with thick paint.

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

LOCATIONS ARE APPROXIMATE.

SOURCE: LMHC 1998b
DRAWING H-2-99034, SH 1 OF 1, REV 2
(USDOE 1989)

Grid Points

	1	2	3	4	5	6	7	8	9	10	11	12
C												
B												
A												

	13	14	15	16	17	18	19	20	21	22	23	24	25
C													
B													
A													

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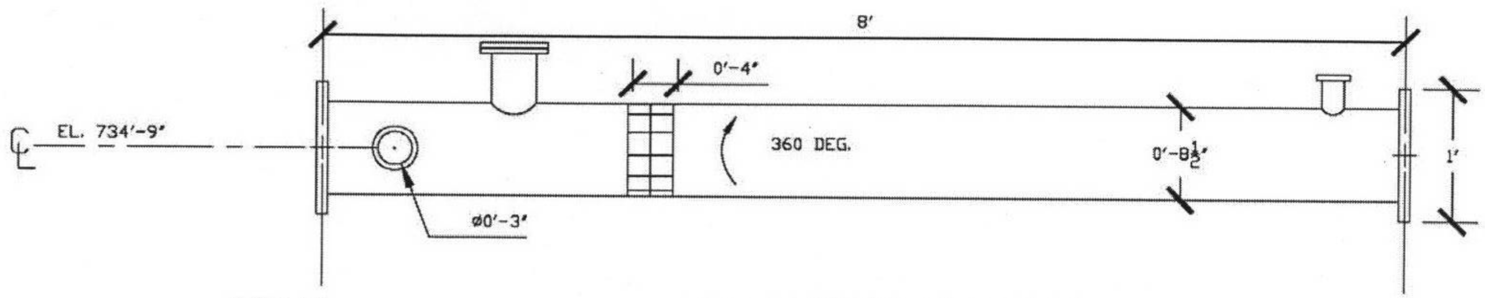
Intercondenser
E-C-2
LOCATION 12

COOPER ZIETZ ENGINEERS, INC

Drawing Number
6.10

Figure 6. 11 Location 13, Aftercondenser E-C-3



SCALE: 1:10

E-C-3 AFTERCONDENSER 4" BAND 360 DEG.

Grid Points

	1	2	3	4	5	6	7	8	9	10	11	12	13
C													
B													
A													

NOTE: E-C-3 Covered with thick paint.

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

LOCATIONS ARE APPROXIMATE.

SOURCE: LMHC 1998b
DRAWING H-2-99034, SH 1 OF 1, REV 2
(USDOE 1989)

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Aftercondenser
E-C-3
LOCATION 13

COOPER ZIETZ ENGINEERS, INC

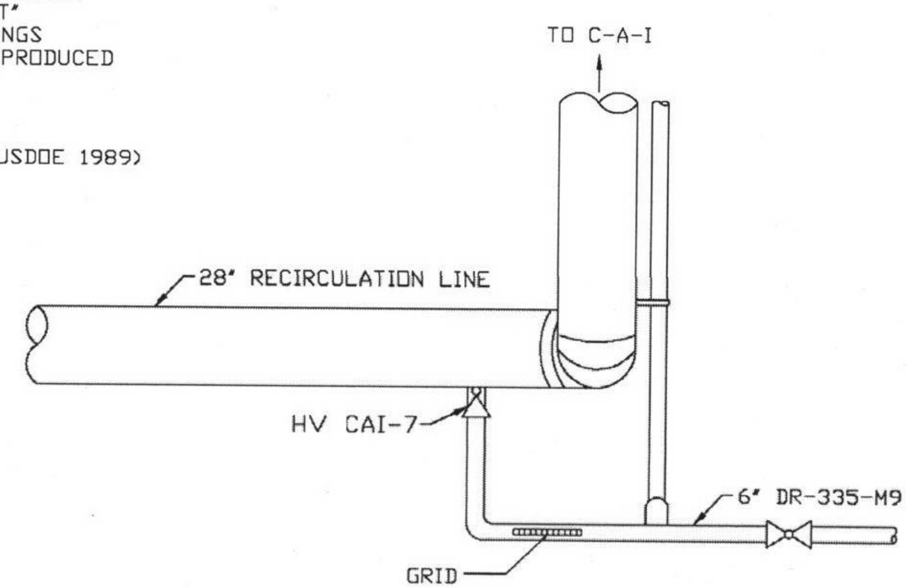
6.11

Figure 6. 12 Location 15, Slurry Drain Line, Line 1-3.

1 READING EVERY 2" 12 PLACES TOTAL

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON 'AS BUILT' ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

SOURCE: LMHC 1998b
DRAWING H-2-99030, SH 1 OF 1, REV 2 (USDOE 1989)



SECT B-B
SCALE: 1:40

Grid Points

	1	2	3	4	5	6	7	8	9	10	11	12
A												

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LOCATION 15
SLURRY DRAIN LINE
LINE 1-3.5

COOPER ZIETZ ENGINEERS, INC.

Drawing Number 6.12

Figure 6. 13 Location 16, Process Condensate Transfer Line

Grid Points

	1	2	3	4	5	6	7	8	9	10	11	12
A												

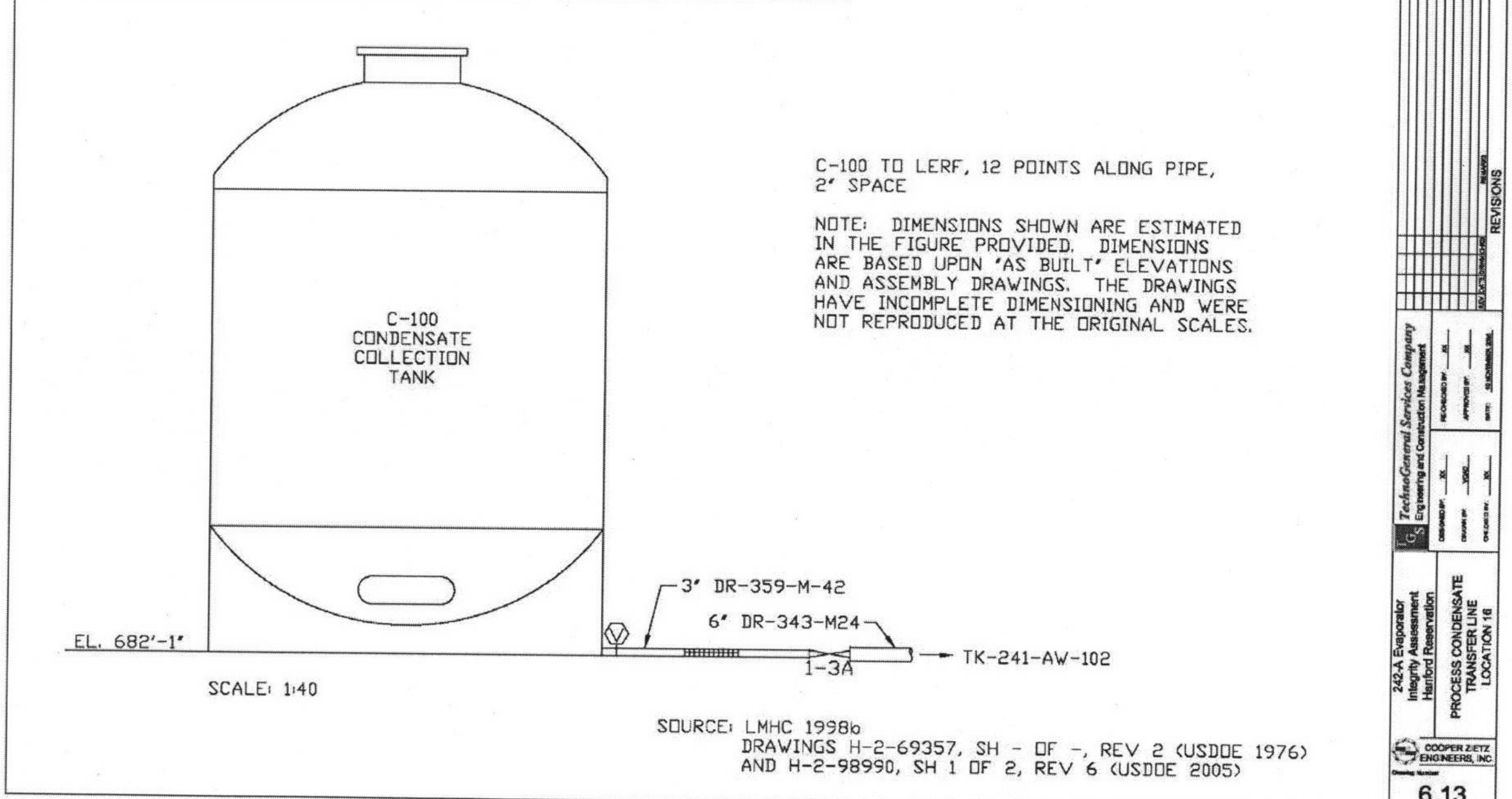
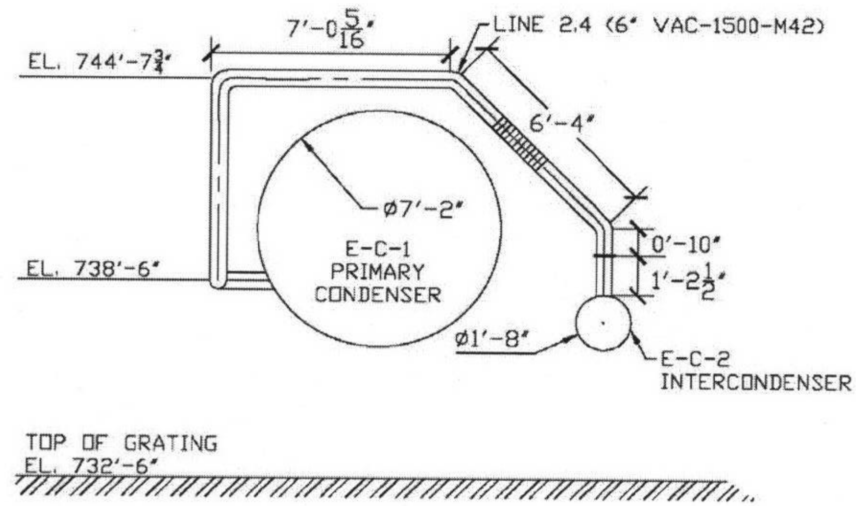


Figure 6. 14 Location 17, Line From E-C-1 To E-C-2

Grid Points

	1	2	3	4	5	6	7	8	9	10	11	12
A												



SCALE: 1:40

12 INDIVIDUAL READINGS ALONG PIPE, 2' SPACE

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

SOURCE: LMHC 1998b
DRAWING H-2-69343, REV 5, SH - OF - (USDOE 1988)

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LOCATION 17
LINE FROM
E-C-1 TO E-C-2

COOPER ZIETZ ENGINEERS, INC

6.14

Figure 6. 15 Location 18

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON 'AS BUILT' ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

SOURCE: DRAWINGS H-2-69340, SH - OF -, REV (USDOE 1977) AND H-2-99029, SH 1 OF 1, REV 2, (USDOE 1989)

DATA (S)

	A
1	
2	
3	

DATA (T)

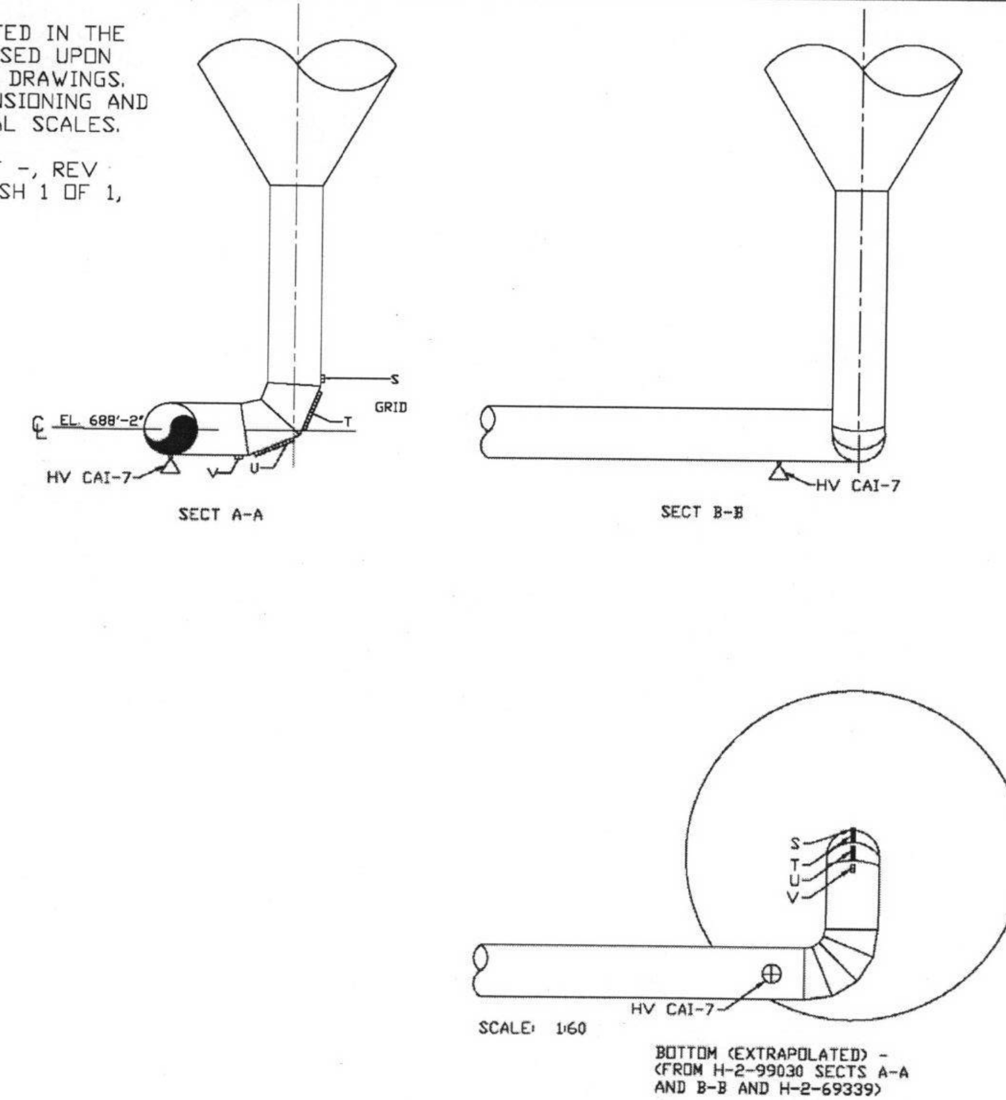
	A
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	

DATA (U)

	A
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	

DATA (V)

	A
1	
2	
3	



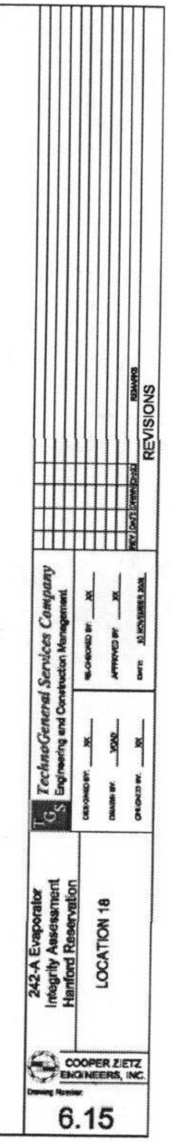
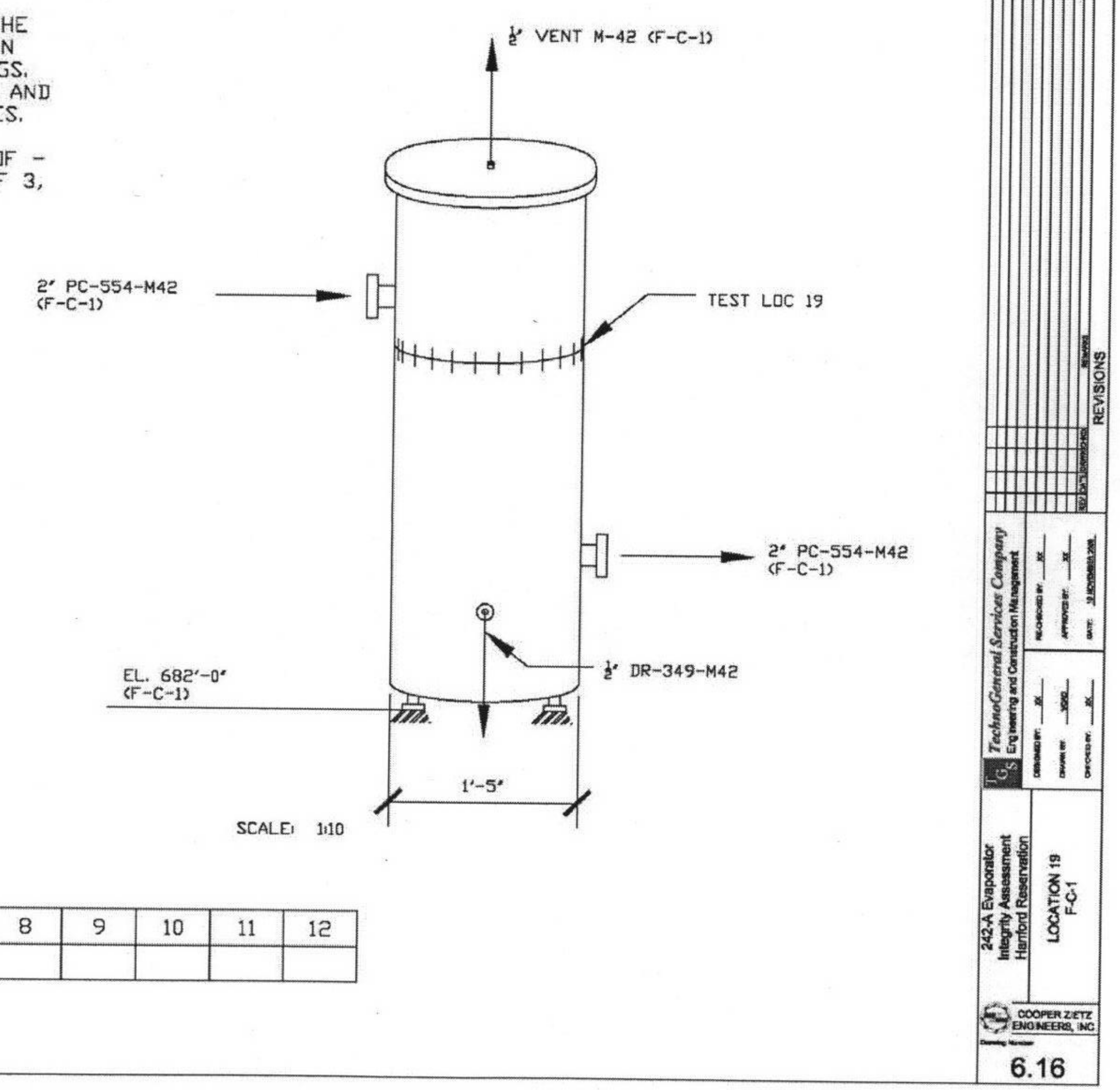


Figure 6. 16 Location 19, F-C-1

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

SOURCE: DRAWINGS H-2-69343, REV 5, SH - OF - (USDOE 1988) AND H-2-99031, SH 2 OF 3, REV 2 (USDOE 1989)



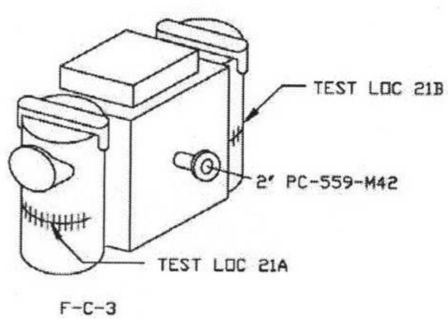
Grid Points

	1	2	3	4	5	6	7	8	9	10	11	12
A												

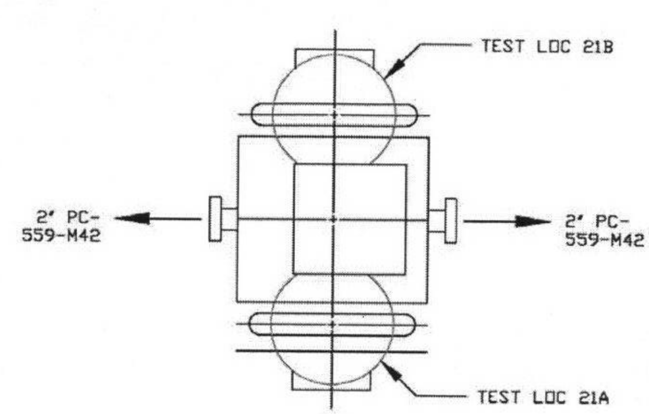
Figure 6. 17 Location 21, Condensate Filter F-C-3

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON 'AS BUILT' ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

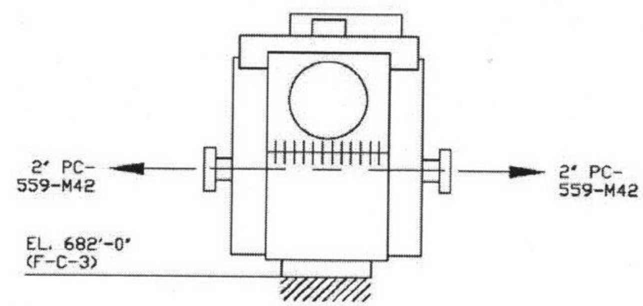
SOURCE: DRAWINGS H-2-69343, REV 5, SH - OF - (USDOE 1988) AND H-2-99031, SH 2 OF 3, REV 2 (USDOE 1989)



ISOMETRIC F-C-3



PLAN VIEW F-C-3
SCALE: 1:10



SIDE VIEW F-C-3
SCALE: 1:10

Grid Points (21A)

	1	2	3	4	5	6	7	8	9	10	11	12
A												

Grid Points (21B)

	1	2	3	4	5	6	7	8	9	10	11	12
B												

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LOCATION 21
CONDENSATE FILTER F-C-3

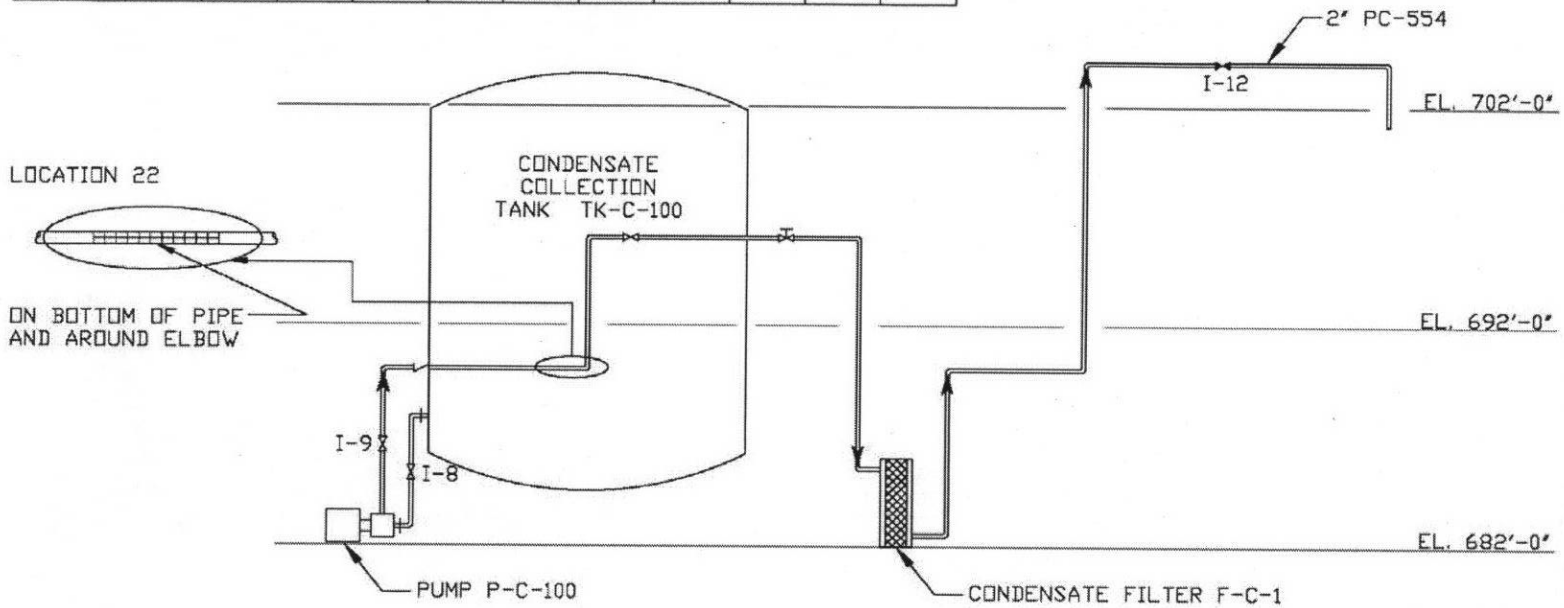
COOPER ZIETZ ENGINEERS, INC.

6.17

Figure 6. 18 Location 22, condensate Recirculation Line, 2" PC-554-M42

Grid Points

	1	2	3	4	5	6	7	8	9	10	11	12
A												



SCALE: 1:60

NOTE: SUITABLILITY OF TEST LOCATION TO BE FIELD VERIFIED AND APPROVED BY THE IQRPE.

DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS AND ELEVATIONS ARE BASED UPON AN "AS BUILT" ELEVATION AND A PROCESS HYDRAULIC DRAWING. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

A DRAWING DEPICTING THE TRUE LENGTH OR GEOMETRY OF THE LINE SHOWN IS NOT CURRENTLY AVAILABLE

MINIMUM 12 INDIVIDUAL WALL THICKNESS MEASUREMENTS.

GRID: 2" WIDE BAND ALONG THE LENGTH OF THE LINE, ON THE BOTTOM OF THE LINE.

SOURCE: DRAWING H-2-69328, SH - OF -, REV 1 (USDOE 1976)

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LOCATION 22
CONDENSATE RECIRCULATION
LINE, 2" PC-554-M42

COOPER ZIETZ ENGINEERS, INC.

6.18

Figure 6. 19 Location 4, 28-inch Recirculation Line

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON 'AS BUILT' ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

SOURCE: DRAWINGS H-2-69340, SH - OF -, REV (USDOE 1977) AND H-2-99029, SH 1 OF 1, REV 2, (USDOE 1989)

DATA (S)

	A
1	
2	
3	

DATA (T)

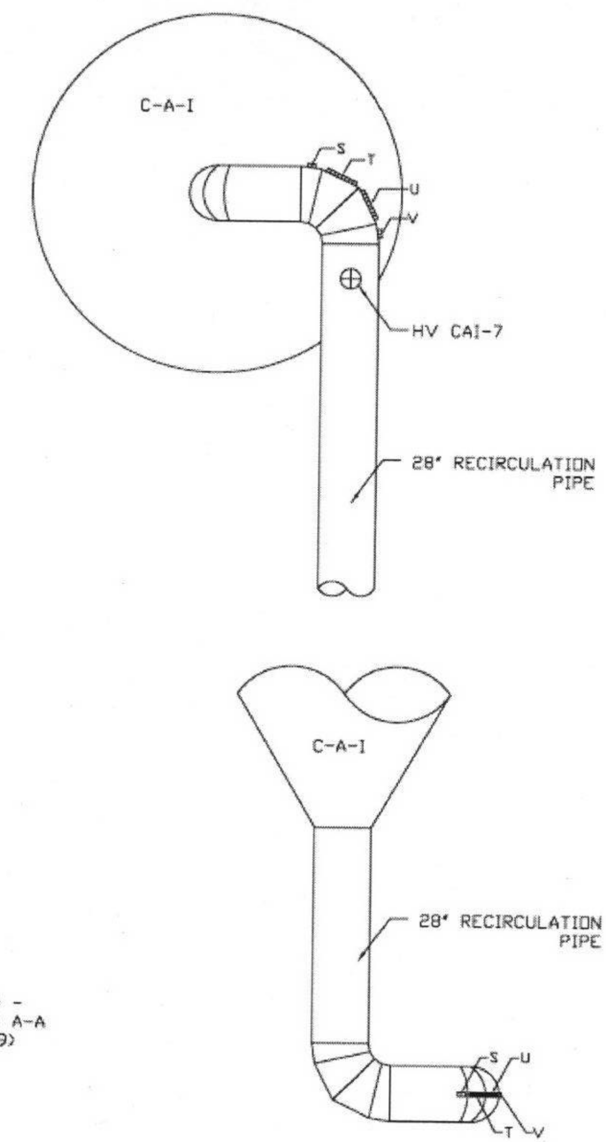
	A
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	

DATA (U)

	A
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	

DATA (V)

	A
1	
2	
3	



BOTTOM (EXTRAPOLATED) - (FROM H-2-99030 SECTS A-A AND B-B AND H-2-69339)

SCALE: 1:60

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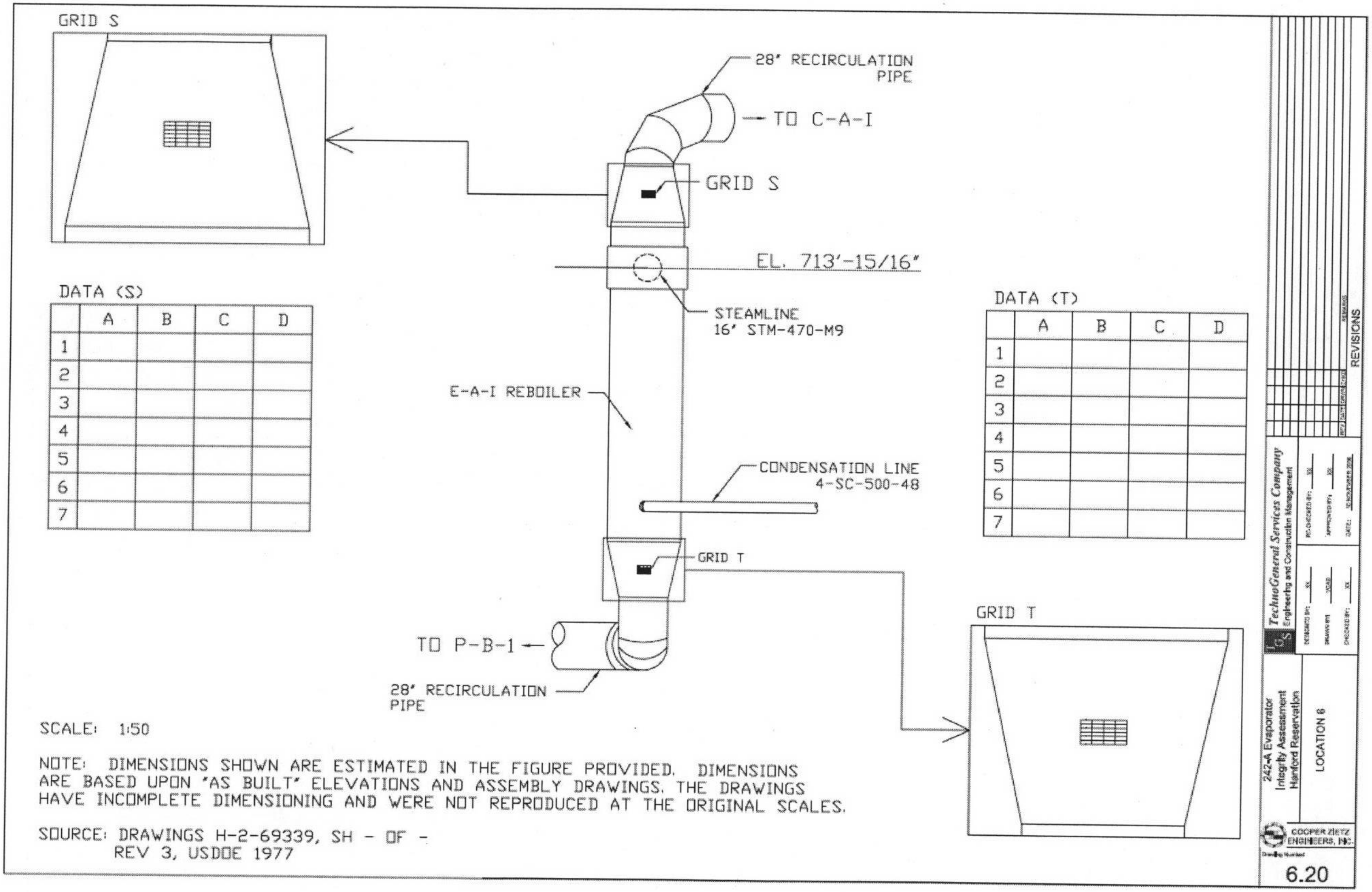
LOCATION 4

COOPER ZIETZ ENGINEERS, INC.

6.19

Figure 6. 20 Location 4, 28-inch Recirculation Line



The 242-A Evaporator TSD unit Operations Contractor is responsible for performance of UT testing. The Operations Contractor will develop a UT inspection work package that meets the requirements of this IAP for review and approval by the IQRPE prior to implementation of the testing activities. Execution of UT activities will be performed by a qualified inspector qualified by the IQRPE in accordance with ASME Section V, Article 5, Ultrasonic Examination Methods for In-service Inspection (ASME 2005).

The UT Test report will typically include the following major sections as an Attachment to the IAR

- Section 1—Introduction
- Section 2—Qualified Personnel, Procedures, and Equipment
- Section 3—Ultrasonic Examination Configuration
- Section 4—Ultrasonic Examination Locations
- Section 5—Ultrasonic Examination Results
- Section 6—Conclusions
- Section 7—Integrity Assessment Certifications
- References
- Figure 1—TSD Unit Location Map
- Figure 2—Transducer Configuration for Examining the components
- Figure 3—Sketch of Scan Paths on the testing components
- Figure 4 - UT Examination Location Maps with UT Data
- Attachment 1- Inspection and Test Personnel Certification
- Attachment 2- UT Thickness Measurement Procedure and Test Report
- Attachment 3 – UT Performance Demonstration Report

6.1.4.1 Inspection Work Package

The following summarizes the UT examination program. Inspection work package shall be prepared by the 242-A Evaporator TSD unit Operations Contractor prior to the actual inspection and shall include the following as a minimum:

- Introduction
- Scope
- Qualified Personnel, Procedures, and Equipment
- UT Testing Components
- Limitations of UT Testing
- UT Testing Procedures
- Test Apparatus
- UT testing Check List/Data Sheets
- Quality Assurance and Safety

- Sequence of Activities and Schedule
- References

The UT shall be performed with approved procedures by CH2M HILL. The following Items shall be considered when developing work package:

- Before UT begins, the areas to be tested need to be clearly identified and a grid pattern must be drawn.
- The surface on which the transducer is placed needs to be clean, and, as it provides a point measurement, the measurement positions need to be selected with consideration of the type of corrosion damage so that the minimum wall thickness can be detected.
- When using a grid to survey a large surface area, the pitch of the grid needs to be selected so that it will detect the damage of concern.
- Care needs to be taken when taking measurements on plant equipment which is painted or coated to ensure that the measurement is just that of the remaining wall.
- Operations personnel will be responsible for preparing the areas such as drawing grids and marking areas prior to UT. 242-A Evaporator operations personnel will provide photography and video equipment and perform the photography and video services.
- Areas will be divided into grids of 2 inches square. For future integrity assessments the tested areas shall be permanently marked in indelible ink. Figures 6-3 to 6-18 show the UT locations to be examined in this IAP.
- Field testing shall be performed using a digital or equivalent ultrasonic thickness gauging device. The instrument shall have the ability directly allowing its operator to instantly evaluate the validity of each and every wall thickness measurements taken.
- Instrument calibration shall be performed at the beginning of the test session and at regular intervals throughout the investigation. Specifications for the UT thickness gage should be included in the test plan.
- A preliminary review of each test location shall be performed to generalize the condition of that particular area from the initial walkdowns report and photographs as discussed in 6.1.1.1.
- Record readings at the locations specified in the work package.
- A photograph of each test location shall be taken in order to illustrate the general test location and supplement the written description.
- Wall thickness measurements taken by the UT method shall be compared with wall thickness of each component based on the design documentation. Differences in thickness shall be documented and appropriate engineering analysis methods shall be conducted to determine the impact of the difference in thickness on the structural integrity of the components. Follow-on NDE will be performed at locations of significant corrosion to identify the extent of damage.

6.1.4.1.1 UT Test Procedure for C-A-1 Evaporator, Locations 1, 2, 3, and 5

Measure the thickness of the 1.07-meter (3.5 feet) diameter evaporator vapor line as close to the expansion joint as possible by UT over a 15.2-centimeter (6-inch) wide band 360 degrees around on the downstream side of the joint. UT of the 6-inch (15.2-centimeter) wide band is to cover 100% of the area. See location 1, on Figure 6-3. Scaffolding will be necessary to reach the expansion joint which is just above the second evaporator platform.

Measure the thickness of 1.07-meter (3.5 feet) evaporator line at the mitered elbow, location 2 on Figure 6-4. UT measurements will be taken on the outside of the mitered elbow over a 0.31-meter (1- foot) wide band along the length of the elbow extending 7.6-centimeter (3 inches) beyond the ends of the elbow. UT is to cover 100% of the grid area. This is a difficult to reach area and will require scaffolding.

Measure the thickness around the circumference of the evaporator shell level with the centerline of the outlet of the reboiler (evaporator liquid/vapor interface line). The area to be tested will be a horizontal band 0.61 meter (2 feet) wide by 1.83 meter (6 feet) long centered at the interface line. UT 100% of the area of the band. See location 3 on Figure 6-5. This may be a difficult to reach area and will require scaffolding.

Measure the thickness of the 71-centimeter (28-inch) mitered elbow closest to P-B-1 pump outlet, location 5 on Figure 6-6. UT a 6-inch wide band along the length of the elbows extending 3 inches beyond the ends of the elbow. UT 100% of the band.

6.1.4.1.2 UT Test Procedure for Reboiler E-A-1, Location 7

Measure the thickness by UT, the outlet elbow, location 7 on Figure 6-7, on the outside of the elbow in a 15.2 centimeter (6 inches) wide band along the length of the elbow extending 7.6 centimeter (3 inches) beyond the ends. UT 100% of the grid areas. This area may require scaffolding to reach.

6.1.4.1.3 Primary Condenser E-C-1, Locations 9A, 9B, and 9C

Measure the shell thickness of the condenser by UT in a band 2 feet (0.61 meter) wide where convenient along the length of the condenser. Location 9A, 9B, and 9C on Figure 6-8.

6.1.4.1.4 Condensate Collection Tank (TK-C-100), Location 11

Measure the thickness around the circumference of the condensate collection tank shell. The area to be tested will be a horizontal band 61 centimeters (2 feet) wide by 1.83 meter (6 feet) long centered at the shell. UT 100% of the area of the bands. See location 11 on Figure 6-9. This may be a difficult to reach area and will require scaffolding.

6.1.4.1.5 Intercondenser (E-C-2), Location 12

Measure the thickness around the circumference of the condenser by UT over a 4-inch (10.2 centimeter) wide band 360 degrees around on the condenser. UT of the 4-inch (10.2 centimeter) wide band is to cover 100% of the area. See location 12, on Figure 6-10.

6.1.4.1.6 Aftercondenser (E-C-3), Location 13

Measure the thickness around the circumference of the condenser by UT over a 4-inch (10.2 centimeter) wide band 360 degrees around on the condenser. UT of the 4-inch

(10.2 centimeter) wide band is to cover 100% of the area. See location 13, on Figure 6-11.

6.1.4.1.7 Slurry Line to 241-AW, Location 15

Measure the thickness of the 6-inch (15.2 centimeter) slurry drain line within the 242-A Evaporator building at grid location A , location 15 (Figure 6-12) using 5.1 centimeter (2 inch) grids. UT a 5.1 centimeter (2-inch) wide band along the length of the line with a minimum of 12 individual readings. UT 100% of the band.

6.1.4.1.8 Drain Line from Condensate Collection Tank (TK-C-100) to LERF, Location 16

Measure the thickness of the 7.6 centimeter (3-inch) drain line at grid location A, location 16 on Figure 6-13 using 5.1 centimeter (2 inch) grids. UT a 5.1 centimeter (2 inch) wide band along the length of the line with a minimum of 12 individual readings. UT 100% of the band.

6.1.4.1.9 Vapor Condensate (VC) Line from E-C-1 to E-C-2 condensers, Location 17

Measure the thickness of the 6-inch (15.2 centimeter) VC line at grid location A, location 17 (Figure 6-14) using 5.1 centimeter (2 inch) grids. UT a 5.1 centimeter (2-inch) wide band along the length of the line with a minimum of 12 individual readings. UT 100% of the band.

6.1.4.1.10 28" (71 centimeter) Recirculation Line, Location 18

71 centimeter (28 inches) Recirculation Line from C-A-1 inlet to P-B-1 inlet at valve HV-CA1-7. Measure the thickness of the 71 centimeter (28-inches) recirculation line at grid locations S, T, U, and V at location 18 (Figure 6-7) using 5.1 centimeter (2-inch) grids. UT a 15.2 centimeter (6 inch) wide band along the length of the mitered elbows extending 7.6 centimeter (3 inch) on each side. UT 100% of the band.

6.1.4.1.11 Condensate Filters (F-C-1 and F-C-3), Locations 19 and 21

Information on the installation and technical specifications for these filters after replacing the ion exchange column is not available at this time. These filters are used to filter the process condensate after leaving the condensate collection tank. The primary condensate filter (F-C-1) has a welded steel housing. The second filter system (F-C-3) has a cast iron housing.

UT at two locations (Location 19 on F-C-1) and Location 21 on F-C-3). These are new locations in this IAP. Accessibility for these locations should be evaluated during initial walkdowns prior to start of the actual UT. Measure the thickness around the circumference of the condensate filters. The area to be tested will be a horizontal band 61 centimeter(2 feet) wide by 61 centimeter (2 feet) long centered at the shell. UT 100% of the area of the bands.

6.1.4.1.12 Condensate Recycle (CR) System Line (2-inch , carbon steel line)from pump, P-C-106 to Filters (F-C-5) and F-C-6), Locations 22

Information on the installation and technical specifications for the condensate recycle system is not available at this time. This system supply process condensate from tank TK-C-100 to the pad sprays and pump seals.

Measure the thickness of this 5.1 centimeter (2 inch) CR line 5.1 centimeter (2 inch) (PC 554-M42) at location 22 using 5.1 centimeter (2 inch) grids. UT a 5.1 centimeter (2 inch) wide band along the length of the line with a minimum of 12 individual readings. UT 100% of the band.

This is a new location in this IAP. Accessibility for this location should be evaluated during initial walkdowns prior to start of the actual UT.

6.1.4.2 Equipment

The UT system (instrument, transducer, scanning device, and cables) shall have the following detection limits (tested at 13 millimeter [0.5 inch] nominal thickness):

- General corrosion/thinning detection within 0.020 inches (0.50 mm).
- Pitting detection within 1.3 millimeter (0.05 inches) (elliptical or hemispherical)
- Crack depth detection within 0.100 inches (2.5 mm), greater than or equal to 13 mm (0.5 inches) long, less than 1.6 centimeter (0.6 inches) long. In the absence of an acceptable cracked sample, a machine notch 1.3 mm (0.05 inches) deep x 25.4 mm (1 inch) long can be used instead of a crack.

Valid calibration documentation will be provided for each piece of equipment used to complete the testing activities conducted in accordance with this IAP.

6.1.4.3 Qualifications of Inspectors

Under contract from CH2M Hill, qualification of personnel participating in the tank inspection program, the UT equipment (instrument and mechanical scanning fixture), and the UT procedure that will be used in the examination of the tank system is required prior to the actual inspection. The capability of the UT system, including personnel and procedures, is to be validated through a Performance Demonstration Test (PDT). The current procedure for the UT is to be based on the Section V, Article 5, Boiler and Pressure Vessel Code defined by the American Society for Mechanical Engineers (ASME).

6.1.5 Secondary Containment Inspection

Secondary containment associated with the 242-A Evaporator System consists of coated or lined concrete with drains for the dangerous waste subsystems. External surfaces of the secondary containment are not readily accessible for inspection, nor are they subject to corrosion concern.

The coated and lined surfaces of the secondary containment will be visually inspected during walk down for conformance to the applicable drawings and for wear, cracks, swelling, blistering, crinkling, deteriorated joint sealant or waterstops (if applicable), and other failures through which dangerous waste could migrate to the underling concrete. An inspection plan will be prepared and accepted by the IQRPE prior to performing the walk down. The completed inspection sheets will be evaluated, summarized, and documented under the direction of the IQRPE for inclusion in the IAR.

6.1.5.1 Inspection Work Package

Inspection work package shall be prepared prior to the actual inspection and shall typically include the following major sections:

- Introduction
- Basis for inspection
- Inspection Components
- Access to Components
- Access constraints
- Inspection Check List
- Inspection Schedule
- Frequency
- Inspection type (general or detailed)
- Safety Measures

The following components in the 242-A Evaporator building structure will be visually inspected for conformance to the applicable drawings and for wear, cracks, swelling, blistering, crinkling, deteriorated joint sealant or waterstops:

- Evaporator room
- Pump Room
- Load out and Hot equipment Storage Room
- Condenser Room
- Aqueous Makeup Room
- HVAC Equipment Room
- Floor Drains and Sumps
- Drain Funnels and Equipment Drain Facilities

6.1.5.2 Equipment

Equipment associated with visual inspection includes, but is not limited to cameras (film, digital, and video), magnifying glasses and mirrors. All equipment used for inspection shall be qualified to assure it meets the lighting and resolution requirements of ASME Section V, Article 9.

6.1.5.3 Qualifications of Inspectors

Inspections shall be performed by qualified personnel to the requirements given in Attachment B-3.

6.2 PC-5000 Transfer Line Subsystem

The following subsections describe the integrity testing methods to be used to assess the PC-5000 transfer line subsystem. A separate inspection work package will be submitted for the PC-5000 condensate transfer line subsystem.

6.2.1 Visual Inspection

Visual inspection of the PC-5000 Transfer Line subsystem will be performed only on accessible areas and instrumentation for evidence of degradation or deformation. This inspection will be performed in conjunction with the hydrostatic pressure testing described in Attachment C-2. The visual inspection will also include a review for consistency with applicable architectural, structural, general arrangement, and piping and instrumentation drawings. Visual inspection will include walk down to inspect the condition of the exposed piping of PC-5000 Process Condensate Transfer Line in the 242-A Evaporator Building and in the LERF Basin 43 and associated support structures and ancillary equipment. Checklists will be developed for the visual examination.

The visual inspection report will include the following major sections: Section 1—Introduction

- Section 2—Qualified Personnel, Procedures, and Equipment
- Section 3—Visual Examination Locations and Components
- Section 4—Visual Examination Results
- Section 5—Conclusions
- Section 6—Integrity Assessment Certifications
- References
- Attachment 1—TSD Unit Location Map
- Attachment 2—Visual Inspection Location Map
- Attachment 3 – Inspection Forms
- Attachment 4—Letters and Memorandums
- Attachment 5—Records and Pictures
- Attachment 6—Field Data

This section describes the activities to be conducted for visual inspection to evaluate the PC-5000 Transfer Line subsystem.

6.2.1.1 Inspection/Walkdown Work Package

Inspection/walkdown work package shall be prepared prior to the actual inspection and shall include the following:

- Introduction
- Scope
- Qualified Personnel, Procedures, and Equipment
- Visual Inspection Components

- Equipment
- Check List
- Quality Assurance and Safety
- Schedule
- References

An initial walkdown should be conducted prior to actual testing of the components to identify accessible and non-accessible components and to check for evidence of degradation or deformation of components. Attachment C-1 lists the components to be inspected for visual inspection for PC-5000 transfer line.

Pumps, Instruments, Flanges, Valves, and leak detection systems associated with PC-5000 transfer line. Examine surface area of all accessible pumps, instruments such as flow indicators, pressure gages, valves, and flanges, paying particular attention to welds, joints, seams, and leak detection system. Note areas of significant degradation or deformation. Photograph and record inspection results on checklist provided.

6.2.1.2 Equipment

Equipment associated with visual inspection includes, but is not limited to cameras (film, digital, and video), and mirrors. All equipment used for inspection shall be qualified to assure it meets the lighting and resolution requirements of ASME Section V, Article 9.

6.2.1.3 Qualifications of Inspectors

Inspections shall be performed by qualified personnel to the requirements given in Attachment B-3.

6.2.2 Hydrostatic Pressure Testing

The 242-A Evaporator TSD unit operations contractor will develop a hydrostatic pressure decay test work package for evaluation and acceptance by the IQRPE prior to performing leak testing. The results of leak testing will be evaluated, summarized, and documented under the direction of the IQRPE for inclusion in the IAR.

The hydrostatic pressure decay test report will typically include the following major sections:

- Section 1—Introduction
- Section 2—Qualified Personnel, Procedures, and Equipment
- Section 3—Leak Testing Procedures
- Section 4—Leak Testing Results
- Section 5—Conclusions
- Section 6—Integrity Assessment Certifications
- References
- Attachment 1—TSD unit Location Map
- Attachment 2—Leak Testing Components Drawings for the PC-5000 Transfer Line

- Attachment 3—Letters and Memorandums
- Attachment 4—Records and Pictures
- Attachment 5—Test Data

The following section describes typical activities to be conducted for hydrostatic pressure testing to evaluate the PC-5000 transfer line.

6.2.2.1 Inspection Work Package

A work package shall be prepared prior to the actual inspection and shall include the following major sections:

- Introduction
- Scope
- Qualified Personnel, Procedures, and Equipment
- Leak Testing Components
- Limitations of Leak Testing
- Leak Testing Procedures
- Test Apparatus
- Check List
- Quality Assurance and Safety
- Sequence of Activities and Schedule
- References

The pressure decay test shall encompass all major components of the PC-5000 transfer line identified in the Attachment C-1. The components listed in Attachment C-1 for the PC-5000 transfer line will be pressure decay tested and visually inspected for evidence of leaks in accordance approved procedures developed with the guidelines of ASME Section XI, Division 1, Class 3 (1989). IWA-5240 "Visual Examination" (VT-2). And IWD-5000 "System Pressure Tests Visual Examination Methods" (VT-2).

For future reference, the areas examined are to be documented with photographs, results, and data sheets.

The following components associated with the PC-5000 Transfer Line will be visually inspected and leak tested for conformance to the applicable drawings and for evidence of leaks in accordance with the guidelines of ASME Section XI, Division 1, Class 3 (1989), IWA-5240 "Visual Examination" (VT-2), and IWD-5000 "System Pressure Tests Visual Examination Methods" (VT-2):

- 6-inch Diameter Containment Pipe
- Instrumentation
- Leak Detection System

6.2.2.2 Equipment and Test Procedures

Attachment C-2 provides the equipment and test procedure for hydrostatic pressure decay testing of the PC-5000 Transfer Line tie-in to the existing two-inch PC556-M42 line down stream of valve HV-RC3-3, in the 242-A Evaporator building and terminates at approximately line station, STA 56+ 47.47, at the LERF Basin 43 (Basin 242AL-43).

6.2.2.3 Qualifications of Inspectors

A CH2M HILL QC Level II inspector or a qualified subcontractor selected by CH2M HILL will be performing the leak testing as described in Attachment C-2. The results of the leak testing will be evaluated, summarized and documented under the direction of the IQRPE.

6.2.3 Ultrasonic Inspection

UT Examination is not recommended for the PC-5000 Process Condensate Transfer Line because the system is buried underground and is not accessible for UT examination.

7.0 INTEGRITY ASSESSMENT CERTIFICATIONS

The IAR will be stamped and signed by a registered professional engineer in the State of Washington, and will be accompanied by the following certification statement:
The 242-A Evaporator System and PC-5000 Condensate Transfer Line Subsystem have been reviewed by the IQRPE. System design, construction, and current conditions have been assessed based on the reviews and inspections described herein, and have been determined to be in compliance with the applicable sections of WAC 173-303-640 and the RCRA Part B Permit (WA 7890008967 Part III Operating Unit 4) for the 242-A Evaporator, which includes the PC-5000 Condensate Transfer Line. This conclusion is based on a review of the documents, inspections, and test results described herein. The certifications below are in accordance with the requirements of WAC 173-303-640(2)(c) and WAC 173-303-810(13)(a).

Report Lead IQRPE:

"I certify under penalty of the law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations."

PE seal

Approved:

Name , PE Date

Position, Company

8.0 ORGANIZATION

This section describes the organizations involved in the integrity assessment activities.

8.1 Internal Organization

CH2M HILL is the co-operator responsible for the 242-A Evaporator System and PC-5000 Transfer Line. Portions of the PC-5000 Transfer Line are located within LERF which is controlled by Fluor Hanford Company.

8.2 External Organization

IQRPE services for the integrity assessment will be provided by TechnoGeneral Services Company (TGS) and their subcontractor, Cooper Zietz Engineers, Inc. This includes oversight of visual inspection, hydrostatic, and UT activities. The lead IQRPE is Mr. Tim Oliver, PE. Former TGS Project Managers are Mr. Robert Goodman, PE, and Mr. Clyde Acree, PE, Mr, Shafik Rifaey, PE is the peer reviewer.

9.0 SCHEDULE

Detailed schedules for integrity assessment activities are the responsibility of CH2M HILL. TGS personnel will participate in weekly scheduling meetings in order to coordinate IQRPE inspection activities and oversight activities of hydrostatic testing and UT activities to be conducted by other CH2M HILL subcontractors. Project milestone and critical path items will be completed in the following order.

Table 9.1 Integrity Assessment Schedule

TASK	COMPLETION
Draft IAP	13 November 2006
Final IAP	5 February 2007
Visual Inspection	To be completed by 12 September 2007
Hydrostatic Testing	C-A-1 to be completed by 12 September 2007 PC-5000 to be completed by 28 September 2007 TK-C-100 completed on 2,and 3 July 2007
Ultrasonic Testing	Completed 13 and 17 April 2007; 1, 2, and 4 May 2007 (Locations 1, 2, 4, 5, 9, 11, 12, 13, 15, 16, 17, 18, 19, 21, and 22); Locations 3, 6, and 7 to be completed by 26 September 2007
Draft IAR	10 days after all testing activities are completed
Final IAR	5 days after all comments on draft IAR are received from CH2M HILL

10.0 SAFETY AND QUALITY ASSURANCE

This section describes the safety and quality assurance requirements for the integrity assessment and procedures for reporting non-conforming conditions.

10.1 General Requirements

Activities associated with this integrity assessment shall be in accordance with applicable Hanford quality and safety procedures. Review and approval of inspections, tests, and analyses performed as part of this integrity assessment shall be in accordance with the appropriate Hanford procedures. Personnel performing inspection and testing support to this assessment must comply with all the applicable 242-A Evaporator training requirements.

10.2 Non-Conforming Conditions

Items that do not physically meet the acceptance criteria defined in this IAP or are not in accordance with TSD unit specifications shall be dispositioned and tracked with the applicable 242-A Evaporator System and Hanford-specific procedures.

Critical changes in design criteria and loading conditions such as minimum wall thickness requirements and design basis shall be noted within the IAR along with recommendations for resolution.

REFERENCES

American Association of State Highway Transportation Officials (AASHTO). 1989. Standard Specifications for Highway Bridges. Washington, D.C.

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LMHC. 1998a. HNF-2331. 1998 Interim 242-A Evaporator Tank System Integrity Assessment Plan. Revision 0. March 31.

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Vitro, 1974. Construction Specification For 242-A Evaporator-Crystallizer Facilities Project B-100, Construction Specification B-100-C1, Automation Industries, Inc. Vitro Engineering Division, Richland, Washington, March 25, 1974.

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Treatment Facility, Washington State Department of Ecology, Olympia, Washington and U.S. Environmental Protection Agency Region 10, Seattle, Washington..

Washington State Department of Transportation (WSDOT). 1988. M41-10-88. Standard Specification for Road, Bridge, and Municipal Construction.

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WHC. 1990b. W-105-C3. Construction Specification for Piping and Electrical for 242-A Evaporator and PUREX Retention Basin. Revision 0.

WHC. 1990c. WHC-EP-0342. 242-A Evaporator Process Condensate Stream-Specific Report. 1990.

WHC. 1991a. WHC-SD-W105-FDC-001. Functional Design Criteria, 242-A Evaporator Condensate Interim Retention Basin. Revision 1.

WHC. 1991b. WHC-SD-WM-WP-099. Integrity Assessment Plan for 242-A Evaporator/LERF Waste Transfer Piping, Project W105. March.

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WHC. 1993c. WHC-SD-WM-ER-112. Integrity Assessment Report For 242-A Evaporator/LERF Waste Transfer Piping, Project W105. July.

ATTACHMENT A

REFERENCE DRAWINGS

(2 pages)

Process and Instrumentation Diagrams

System	Drawing Number	Drawing Title
Vapor-Liquid Separator	H-2-98988 Sheet 1	P & ID Evaporator Recirculation System
Reboiler/Recirculation Line	H-2-98988 Sheet 2	P & ID Evaporator Recirculation System
Slurry System	H-2-98989 Sheet 1	P & ID Slurry System
Condensate Collection Tank	H-2-98990 Sheet 1	P & ID Process Condensate System
Secondary Containment Drain System	H-2-98995 Sheet 1	P & ID Drain System
Secondary Containment Drain System	H-2-98995 Sheet 2	P & ID Drain System
Condensers	H-2-98999 Sheet 1	P & ID Vacuum Condenser System
Pump Room Sump	H-2-99002 Sheet 1	P & ID Jet Gang Valve System
Condensate Recycle System	H-2-99003 Sheet 1	P & ID Filtered Raw Water System
PC-5000 Transfer Line System	H-2-88766 Sheet 1	P & ID LERF Basin & ETF Influent Evaporator
PC-5000 Transfer Line System	H-2-88766 Sheet 3	P & ID LERF Basin & ETF Influent Evaporator
PC-5000 Transfer Line System	H-2-79614	Piping Plan – Catch Basin 242AL-43
PC-5000 Transfer Line System	H-2-98990 sheet 1	P & ID Process Condensate System

242-A Evaporator Secondary Containment Systems Drawings

System	Drawing Number	Drawing Title
242-A Building	H-2-69277 Sheet 1	Structural Foundation Plan Sections & General Notes – Areas 1 & 2
	H-2-69278 Sheet 1	Structural Foundation Elevations & Details – Areas 1 & 2
	H-2-69279 Sheet 1	Structural First Floor Plan & AMU – Areas 1 & 2
Pump Room Sump Drainage	H-2-69352 Sheet 1	Sections Process Waste Drainage
242-A Building Drainage	H-2-69354 Sheet 1	Plan Process Waste Drainage
Pump Room Sump	H-2-69369 Sheet 1	Pump Room Sump Assembly & Details

ATTACHMENT B

242-A EVAPORATOR SYSTEM AND ANCILLIARY EQUIPMENT LIST

- **Attachment B-1** **List of Components to be Leak Tested for Vapor-Liquid Separator (5 pages)**
- **Attachment B-2** **List of Components to be Leak Tested for Condensate Collection Tank (4 pages)**
- **Attachment B-3** **Test Procedure for Visual Examination (2 pages)**
- **Attachment B-4** **Level Draw Down Leak Test Procedures for Vapor Liquid Separator (7 pages)**
- **Attachment B-5** **Level Draw Down Leak Test Procedures for Condensate Collection Tank (5 pages)**

Attachment B-1
(Vapor-Liquid Separator and Anoillary Equipment)

Test	Component ID	Description	Isolation Point	Isolation from (component)	Item to be Photographed	Line Segment Description	Specifications / Materials of Construction	Accessibility / Insulated	P&ID	Maximim/Design Values		Operating Values		Test Pressure	Comments
										Flow/Pressure	Temperature	Operating	Temperature		
Test 1 (Leak Test - Evaporator Reboiler Loop)															
242 A Leak Test	C-A-1	Vapor - Liquid Separator			Vessel C-A-1 (How - from where to where, etc.)	Vessel	14' OD x 18' long x ¼" thick, 304L SS	Vessel insulated, instrument line not insulated	H-2-98988, Sheet 1 of 1	Full Vacuum (Vapor Section); 16,000 gpm (Lower Circulation Pipe)	200°F (VS & LCP)	0.68 - 1.64 psia (Vapor Section); 14,000 - 16,000 gpm (Lower Circulation Pipe_	<150°F (VS & LCP)		
242 A Leak Test	C-A-1	Vapor - Liquid Separator	Valve 5-109 is required to be open to support level measurement in C-A-1	½" I-CAI-M9	Valve 5-109	Vessel	14' OD x 18' long x ¼" thick, 304L SS	Vessel insulated, instrument line not insulated	H-2-98988, Sheet 1 of 1	Full Vacuum (Vapor Section); 16,000 gpm (Lower Circulation Pipe)	200°F (VS & LCP)	0.68 - 1.64 psia (Vapor Section); 14,000 - 16,000 gpm (Lower Circulation Pipe_	<150°F (VS & LCP)		
242 A Leak Test	C-A-1	Vapor - Liquid Separator	Valve 5-110 is required to be open to support level measurement in C-A-1	½" I-CAI-M9	Valve 5-110	Vessel	14' OD x 18' long x ¼" thick, 304L SS	Vessel insulated, instrument line not insulated	H-2-98988, Sheet 1 of 1	Full Vacuum (Vapor Section); 16,000 gpm (Lower Circulation Pipe)	200°F (VS & LCP)	0.68 - 1.64 psia (Vapor Section); 14,000 - 16,000 gpm (Lower Circulation Pipe_	<150°F (VS & LCP)		
242 A Leak Test	C-A-1	Vapor - Liquid Separator	Valve 5-111 is required to be open to support level measurement in C-A-1	½" I-CAI-M9	Valve 5-111	Vessel	14' OD x 18' long x ¼" thick, 304L SS	Vessel insulated, instrument line not insulated	H-2-98988, Sheet 1 of 1	Full Vacuum (Vapor Section); 16,000 gpm (Lower Circulation Pipe)	200°F (VS & LCP)	0.68 - 1.64 psia (Vapor Section); 14,000 - 16,000 gpm (Lower Circulation Pipe_	<150°F (VS & LCP)		
242 A Leak Test	C-A-1	Vapor - Liquid Separator	Valve 5-112 is required to be open to support level measurement in C-A-1	½" I-CAI-M9	Valve 5-112	Vessel	14' OD x 18' long x ¼" thick, 304L SS	Vessel insulated, instrument line not insulated	H-2-98988, Sheet 1 of 1	Full Vacuum (Vapor Section); 16,000 gpm (Lower Circulation Pipe)	200°F (VS & LCP)	0.68 - 1.64 psia (Vapor Section); 14,000 - 16,000 gpm (Lower Circulation Pipe_	<150°F (VS & LCP)		
242 A Leak Test	C-A-1	Vapor - Liquid Separator	Valve 5-113 is required to be open to support level measurement in C-A-1	½" I-CA1-3-M9	Valve 5-113	Vessel	14' OD x 18' long x ¼" thick, 304L SS	Vessel insulated, instrument line not insulated	H-2-98988, Sheet 1 of 1	Full Vacuum (Vapor Section); 16,000 gpm (Lower Circulation Pipe)	200°F (VS & LCP)	0.68 - 1.64 psia (Vapor Section); 14,000 - 16,000 gpm (Lower Circulation Pipe_	<150°F (VS & LCP)		
242 A Leak Test	C-A-1	Vapor - Liquid Separator	Valve 5-114 is required to be open to support level measurement in C-A-1	½" I-CA1-2-M9	Valve 5-114	Vessel	14' OD x 18' long x ¼" thick, 304L SS	Vessel insulated, instrument line not insulated	H-2-98988, Sheet 1 of 1	Full Vacuum (Vapor Section); 16,000 gpm (Lower Circulation Pipe)	200°F (VS & LCP)	0.68 - 1.64 psia (Vapor Section); 14,000 - 16,000 gpm (Lower Circulation Pipe_	<150°F (VS & LCP)		
242 A Leak Test	C-A-1	Vapor - Liquid Separator	Valve 5-115 is required to be open to support level measurement in C-A-1	½" I-CA1-1-M9	Valve 5-115	Vessel	14' OD x 18' long x ¼" thick, 304L SS	Vessel insulated, instrument line not insulated	H-2-98988, Sheet 1 of 1	Full Vacuum (Vapor Section); 16,000 gpm (Lower Circulation Pipe)	200°F (VS & LCP)	0.68 - 1.64 psia (Vapor Section); 14,000 - 16,000 gpm (Lower Circulation Pipe	<150°F (VS & LCP)		
242 A Leak Test	C-A-1	Vapor - Liquid Separator	NA	TE CA1-6	TE CA1-6	Vessel	14' OD x 18' long x ¼" thick, 304L SS	Insulated	H-2-98988, Sheet 1 of 1	Full Vacuum (Vapor Section); 16,000 gpm (Lower Circulation Pipe)	200°F (VS & LCP)	0.68 - 1.64 psia (Vapor Section); 14,000 - 16,000 gpm (Lower Circulation Pipe_	<150°F (VS & LCP)		Instrument does not input or extract fluids or vapors from system; however, if leaks are observed, blanking at flange and/or replacing gasketing may be req'd.
242 A Leak Test	28" Recirculation Line	Evaporator / Recirculation	NA (part of loop)	NA (part of loop)	28" Recirculation Line	from C-A-1 to P-B-1 inlet	¼" thick, SS	Insulated	H-2-98988, Sheets 1 of 1 and 2 of 2						
242 A Leak Test	28" Recirculation line	Evaporator / Recirculation	NA (part of loop)	NA (part of loop)	28" Recirculation Line	from E-A-1 to C-A-1	¼" thick, SS	Insulated	H-2-98988, Sheets 1 of 1 and 2 of 2						
242 A Leak Test	28" Recirculation line	Evaporator / Recirculation	NA (part of loop)	NA (part of loop)	28" Recirculation Line	from P-B-1 outlet to E-A-1 inlet	¼" thick, SS	Insulated	H-2-98988, Sheet 2 of 2						
242 A Leak Test	28" Recirculation Line	Evaporator / Recirculation	Valve 5-116 is required to be open to support level measurement in C-A-1	½" I-CAI-8-M9	Valve 5-116		¼" thick, SS	Vessel insulated, instrument line not insulated	H-2-98988, Sheets 1 of 1 and 2 of 2						
242 A Leak Test	28" Recirculation Line	Evaporator / Recirculation	Isolate at valves HV-F2-1, HV-F2-2, HV-F2-4, HV-F2-5 & HV-F2-6	3" SL-130-M9	HV-F2-1	from C-A-1 to P-B-1 inlet	¼" thick, SS	28" line insulated, 3" line not insulated	H-2-98988, Sheet 2 of 2						
242 A Leak Test	28" Recirculation Line	Evaporator / Recirculation	Isolate at valves HV-F2-1, HV-F2-2, HV-F2-4, HV-F2-5 & HV-F2-6	3" SL-130-M9	HV-F2-2										
242 A Leak Test	28" Recirculation Line	Evaporator / Recirculation	Isolate at valves HV-F2-1, HV-F2-2, HV-F2-4, HV-F2-5 & HV-F2-6	3" SL-130-M9	HV-F2-4										
242 A Leak Test	28" Recirculation Line	Evaporator / Recirculation	Isolate at valves HV-F2-1, HV-F2-2, HV-F2-4, HV-F2-5 & HV-F2-6	3" SL-130-M9	HV-F2-5 & HV-F2-6										
242 A Leak Test	28" Recirculation Line	Evaporator / Recirculation	Isolate at valves HV-F2-1, HV-F2-2, HV-F2-4, HV-F2-5 & HV-F2-6	3" SL-130-M9	HV-F2-6										
242 A Leak Test	P-B-1	Recirculation Pump	NA (part of loop)	NA (part of loop)	P-B-1	pump	ASTM A296 Gr CF-8 and Gr GF-8, 14,000 gpm capacity.	Not insulated	H-2-98988, Sheet 2 of 2	14,000 gpm/ 13.2 ft TDH					
242 A Leak Test	Recirculation Pump water seal	Recirculation Pump water seal	Not isolated, seal water will be operating during leak test.	3/4"FRW-652-M9	Recirculation Pump water seal	3/4"FRW-652-M9 to P-B-1 water seal		Not insulated	H-2-98988, Sheet 1 of 1						
242 A Leak Test	Recirculation Pump water seal	Recirculation Pump water seal	Not isolated, seal water will be operating during leak test.	1/2" SEAL CAVITY DRAIN		from P-B-1 water seal to 1/2" SEAL CAVITY DRAIN		Not insulated	H-2-98988, Sheet 1 of 1						
242 A Leak Test	Recirculation Pump water seal	Recirculation Pump water seal	Not isolated, seal water will be operating during leak test.	1/2" SEAL WATER OUT		1/2" SEAL WATER OUT to P-B-1 water seal		Not insulated	H-2-98988, Sheet 1 of 1						
242 A Leak Test	28" Recirculation Line	Evaporator / Recirculation	Isolate at valves HV-F2-1, HV-F2-2, HV-F2-4, HV-F2-5 & HV-F2-6	3" SL-130-M9	HV-F2-1	from P-B-1 outlet to E-A-1 inlet	¼" thick, SS	28" line insulated, 3" line not insulated	H-2-98988, Sheet 2 of 2						
242 A Leak Test	28" Recirculation Line	Evaporator / Recirculation	Isolate at valves HV-F2-1, HV-F2-2, HV-F2-4, HV-F2-5 & HV-F2-6	3" SL-130-M9	HV-F2-2										
242 A Leak Test	28" Recirculation Line	Evaporator / Recirculation	Isolate at valves HV-F2-1, HV-F2-2, HV-F2-4, HV-F2-5 & HV-F2-6	3" SL-130-M9	HV-F2-4										
242 A Leak Test	28" Recirculation Line	Evaporator / Recirculation	Isolate at valves HV-F2-1, HV-F2-2, HV-F2-4, HV-F2-5 & HV-F2-6	3" SL-130-M9	HV-F2-5										

Attachment B-1
(Vapor-Liquid Separator and Ancillary Equipment)

Test	Component ID	Description	Isolation Point	Isolation from (component)	Item to be Photographed	Line Segment Description	Specifications / Materials of Construction	Accessibility / Insulated	P&ID	Maximim/Design Values		Operating Values		Test Pressure	Comments
										Flow/Pressure	Temperature	Operating	Temperature		
242 A Leak Test	28" Recirculation Line	Evaporator / Recirculation	isolate at valves HV-F2-1, HV-F2-2, HV-F2-4, HV-F2-5 & HV-F2-6	3" SL-130-M9	HV-F2-6										
242 A Leak Test	28" Recirculation Line	Evaporator / Recirculation	isolate at valves HV-CA1-2 & HV-CA-2A (block position for both valves)	3" SL-M9	HV-CA1-2	from P-B-1 outlet to E-A-1 inlet	¼" thick, SS	28" line insulated, 3" line not insulated	H-2-98989 / H-2-98988, Sheet 2 of 2						
242 A Leak Test	28" Recirculation Line	Evaporator / Recirculation	isolate at valves HV-CA1-2 & HV-CA-2A (block position for both valves)	3" SL-M9	HV-CA-2A										
242 A Leak Test	28" Recirculation Line	Evaporator / Recirculation	isolate at valve HV-CA-1-1	3" SN-251-M9	HV-CA-1-1	from P-B-1 outlet to E-A-1 inlet	¼" thick, SS	insulated	H-2-98988, Sheet 2 of 2						Leakage through this valve goes to 241-AW-102
242 A Leak Test	28" Recirculation Line	Evaporator / Recirculation	NA	FE CA1-7	FE CA1-7	from C-A-1 to P-B-1 inlet	¼" thick, SS	insulated	H-2-98988, Sheet 2 of 2						instrument does not input or extract fluids or vapors from system; however, if leaks are observed, blanking at flange and/or replacing gasketing may be req'd.
242 A Leak Test	28" Recirculation Line	Evaporator / Recirculation	isolate at valve HV-CA1-7	6" DR-335-M9	HV-CA1-7	from C-A-1 to P-B-1 inlet	¼" thick, SS	2	H-2-98989						
242 A Leak Test	28" Recirculation Line	Evaporator / Recirculation	NA	TE EA1-7	TE EA1-7	from E-A-1 to C-A-1	¼" thick, SS	insulated	H-2-98988, Sheet 2 of 2						instrument does not input or extract fluids or vapors from system; however, if leaks are observed, blanking at flange and/or replacing gasketing may be req'd.
242 A Leak Test	E-A-1	Reboiler			E-A-1 (Reboiler) - how - from where to where, etc.										
242 A Leak Test	E-A-1	Reboiler	NA	PE EA1-2	PE EA1-2	Reboiler (exit)		insulated	H-2-98988, Sheet 2 of 2						
242 A Leak Test	E-A-1	Reboiler	NA	NA (part of loop)		NA (part of loop)	Primary shell is 40½" OD x 14' ½" long x ¼" thick 304L SS, secondary shell is 50" OD X 14' ½" long x 5/16" thick 304L SS. Tube sheets are 40½" OD x 1¼" thick, 304L bundle consists of 364 1½" OD x 14 ga. seamless SS tubes (Figure B.1b, E-A-1 Reboiler)	insulated	H-2-98988, Sheet 2 of 2	100 psig (Shell), Full Vacuum (Tubes); 16,000 gpm	250°F (tube); 350°F (shell)	14,000 - 16,000gpm (tube); 3 - 8 psig (shell)	<150°F (tube); <240°F (shell)		
242 A Leak Test	E-A-1	Reboiler	Steam supply line to reboiler to be pressurized with air during leak test.	18" STM (10 PSIG) 470-M9	18" STM (10 PSIG) 470-M9 (flange on E-A-1 Reboiler)	Reboiler (exit)		insulated	H-2-98988, Sheet 2 of 2						A leak test of the steam side of the reboiler will be performed prior to performance of leak test
242 A Leak Test	E-A-1	Reboiler	NA	PE EA1-12	PE EA1-12	Reboiler (inlet)		insulated	H-2-98988, Sheet 2 of 2						
242 A Leak Test	E-A-1	Reboiler	Steam condesate line from reboiler to be pressurized with air during leak test.	4" SC-500-M9	4" SC-500-M9 (Flange on E-A-1 (reboiler)	Reboiler		insulated	H-2-98988, Sheet 2 of 2						A leak test of the steam side of the reboiler will be performed prior to performance of leak test
Ancillary Equipment															
No Test (FRW / Above Vapor-Condensate Operating Level)	C-A-1	Vapor - Liquid Separator	blank at unidentified nozzles (C-A-1) (4 typical) (upper deentrainment pad / upper pad bottom) or valve off at HV-CA1-10	1" FRW-654-M9		Vessel	14' OD x 18' long x ¼" thick, 304L SS	Presumed insulated	H-2-98988, Sheet 1 of 2	Full Vacuum (Vapor Section); 16,000 gpm (Lower Circulation Pipe)	200°F (VS & LCP)	0.68 - 1.64 psia (Vapor Section); 14,000 - 16,000 gpm (Lower Circulation Pipe_	<150°F (VS & LCP)		
No Test (FRW / Above Vapor-Condensate Operating Level)	C-A-1	Vapor - Liquid Separator	blank at unidentified nozzles (C-A-1) (4 typical) (upper deentrainment pad / upper pad bottom) or valve off at HV-CA1-11 (system boundary)	1" FRW-656-M9		Vessel	14' OD x 18' long x ¼" thick, 304L SS	Presumed insulated	H-2-98988, Sheet 1 of 1	Full Vacuum (Vapor Section); 16,000 gpm (Lower Circulation Pipe)	200°F (VS & LCP)	0.68 - 1.64 psia (Vapor Section); 14,000 - 16,000 gpm (Lower Circulation Pipe_	<150°F (VS & LCP)		
No Test (FRW / Above Vapor-Condensate Operating Level)	C-A-1	Vapor - Liquid Separator	blank at unidentified nozzles (C-A-1) (4 typical) (upper deentrainment pad / upper pad bottom) or valve at HV-CA1-12 (system boundary)	1" FRW-657-M9		Vessel	14' OD x 18' long x ¼" thick, 304L SS	Presumed insulated	H-2-98988, Sheet 1 of 1	Full Vacuum (Vapor Section); 16,000 gpm (Lower Circulation Pipe)	200°F (VS & LCP)	0.68 - 1.64 psia (Vapor Section); 14,000 - 16,000 gpm (Lower Circulation Pipe_	<150°F (VS & LCP)		
No Test (FRW / Above Vapor-Condensate Operating Level)	C-A-1	Vapor - Liquid Separator	blank at unidentified nozzles (C-A-1) (4 typical) (upper deentrainment pad / upper pad bottom) or valve off at HV-CA1-13 (system boundary)	1" FRW-658-M9		Vessel	14' OD x 18' long x ¼" thick, 304L SS	Presumed insulated	H-2-98988, Sheet 1 of 1	Full Vacuum (Vapor Section); 16,000 gpm (Lower Circulation Pipe)	200°F (VS & LCP)	0.68 - 1.64 psia (Vapor Section); 14,000 - 16,000 gpm (Lower Circulation Pipe_	<150°F (VS & LCP)		

Attachment B-1
(Vapor-Liquid Separator and Ancillary Equipment)

Test	Component ID	Description	Isolation Point	Isolation from (component)	Item to be Photographed	Line Segment Description	Specifications / Materials of Construction	Accessibility / Insulated	P&ID	Maximim/Design Values		Operating Values		Test Pressure	Comments
										Flow/Pressure	Temperature	Operating	Temperature		
No Test (FRW / Above Vapor-Condensate Operating Level)	C-A-1	Vapor - Liquid Separator	blank at unidentified nozzles (C-A-1) (4 typical) (lower deentrainment pad / lower pad top) or valve at HV-CA1-14 (system boundary)	1" FRW-665-M9		Vessel	14' OD x 18' long x ¾" thick, 304L SS	Presumed insulated	H-2-98988, Sheet 1 of 1	Full Vacuum (Vapor Section); 16,000 gpm (Lower Circulation Pipe)	200°F (VS & LCP)	0.68 - 1.64 psia (Vapor Section); 14,000 - 16,000 gpm (Lower Circulation Pipe_	<150°F (VS & LCP)		
No Test (FRW / Above Vapor-Condensate Operating Level)	C-A-1	Vapor - Liquid Separator	blank at unidentified nozzle or flange (C-A-1) from Pump P-E-102 (antifoam) (system boundary)	¾" AF-301-M9		Vessel	14' OD x 18' long x ¾" thick, 304L SS	Presumed insulated	H-2-98988, Sheet 1 of 1	Full Vacuum (Vapor Section); 16,000 gpm (Lower Circulation Pipe)	200°F (VS & LCP)	0.68 - 1.64 psia (Vapor Section); 14,000 - 16,000 gpm (Lower Circulation Pipe_	<150°F (VS & LCP)		
No Test (FRW / Above Vapor-Condensate Operating Level)	C-A-1	Vapor - Liquid Separator	blank at unidentified nozzles (C-A-1) (4 typical) from filtered raw water HDR	1" FRW-668-M9		Vessel	14' OD x 18' long x ¾" thick, 304L SS	Presumed insulated	H-2-98988, Sheet 1 of 1	Full Vacuum (Vapor Section); 16,000 gpm (Lower Circulation Pipe)	200°F (VS & LCP)	0.68 - 1.64 psia (Vapor Section); 14,000 - 16,000 gpm (Lower Circulation Pipe_	<150°F (VS & LCP)		
No Test (FRW / Above Vapor-Condensate Operating Level)	C-A-1	Vapor - Liquid Separator	blank at unidentified nozzle or flange (C-A-1) (lower pad bottom) or valve at HV-CA1-15 (system boundary)	1" FRW-663-M9		Vessel	14' OD x 18' long x ¾" thick, 304L SS	Presumed insulated	H-2-98988, Sheet 1 of 1	Full Vacuum (Vapor Section); 16,000 gpm (Lower Circulation Pipe)	200°F (VS & LCP)	0.68 - 1.64 psia (Vapor Section); 14,000 - 16,000 gpm (Lower Circulation Pipe_	<150°F (VS & LCP)		
No Test (FRW / Above Vapor-Condensate Operating Level)	C-A-1	Vapor - Liquid Separator	blank at unidentified nozzles (C-A-1) (4 typical) (upper pad top) or valve at HV-CA1-13	1" FRW-659-M9		Vessel	14' OD x 18' long x ¾" thick, 304L SS	Presumed insulated	H-2-98988, Sheet 1 of 1	Full Vacuum (Vapor Section); 16,000 gpm (Lower Circulation Pipe)	200°F (VS & LCP)	0.68 - 1.64 psia (Vapor Section); 14,000 - 16,000 gpm (Lower Circulation Pipe_	<150°F (VS & LCP)		
No Test (FRW / Above Vapor-Condensate Operating Level)	C-A-1	Vapor - Liquid Separator	blank at unidentified nozzles (C-A-1) (4 typical) (upper pad top) or valve at HV-CA1-12	1" FRW-660-M9		Vessel	14' OD x 18' long x ¾" thick, 304L SS	Presumed insulated	H-2-98988, Sheet 1 of 1	Full Vacuum (Vapor Section); 16,000 gpm (Lower Circulation Pipe)	200°F (VS & LCP)	0.68 - 1.64 psia (Vapor Section); 14,000 - 16,000 gpm (Lower Circulation Pipe_	<150°F (VS & LCP)		
No Test (FRW / Above Vapor-Condensate Operating Level)	C-A-1	Vapor - Liquid Separator	blank at unidentified nozzles (C-A-1) (4 typical) (upper pad top) or valve at HV-CA1-11	1" FRW-661-M9		Vessel	14' OD x 18' long x ¾" thick, 304L SS	Presumed insulated	H-2-98988, Sheet 1 of 1	Full Vacuum (Vapor Section); 16,000 gpm (Lower Circulation Pipe)	200°F (VS & LCP)	0.68 - 1.64 psia (Vapor Section); 14,000 - 16,000 gpm (Lower Circulation Pipe_	<150°F (VS & LCP)		
No Test (FRW / Above Vapor-Condensate Operating Level)	C-A-1	Vapor - Liquid Separator	blank at unidentified nozzles (C-A-1) (4 typical) (upper pad top) or valve at HV-CA1-11	1" FRW-662-M9		Vessel	14' OD x 18' long x ¾" thick, 304L SS	Presumed insulated	H-2-98988, Sheet 1 of 1	Full Vacuum (Vapor Section); 16,000 gpm (Lower Circulation Pipe)	200°F (VS & LCP)	0.68 - 1.64 psia (Vapor Section); 14,000 - 16,000 gpm (Lower Circulation Pipe_	<150°F (VS & LCP)		
No Test (Vapor / Above Vapor-Condensate Operating Level)	42" Vapor Line	Vapor	Not isolated from C-A-1	E-C-1		from C-A-1 to E-C-1	5/16" thick, SS	Insulated inside evaporator room	H-2-98988, Sheet 1 of 2						Not included in test boundary, line is located above water level during test
No test (FRW)	1" FRW-654-M9	Filtered raw water				to unidentified nozzles (C-A-1) (4 typical) (upper deentrainment pad / upper pad bottom) through spray ring from HV-CA1-10 (system boundary)			H-2-98988, Sheet 1 of 1						HV-CA1-10 (system boundary) or at flange (input is not a waste)
No test (FRW)	1" FRW-656-M9	Filtered raw water				to unidentified nozzles (C-A-1) (4 typical) (upper deentrainment pad / upper pad bottom) through spray ring from HV-CA1-11 (system boundary)			H-2-98988, Sheet 1 of 1						HV-CA1-11 (system boundary) or at flange (input is not a waste)

Attachment B-1
(Vapor-Liquid Separator and Ancillary Equipment)

Test	Component ID	Description	Isolation Point	Isolation from (component)	Item to be Photographed	Line Segment Description	Specifications / Materials of Construction	Accessibility / Insulated	P&ID	Maximim/Design Values		Operating Values		Test Pressure	Comments
										Flow/Pressure	Temperature	Operating	Temperature		
No test (FRW)	1" FRW-657-M9	Filtered raw water				to unidentified nozzles (C-A-1) (4 typical) (upper deentrainment pad / upper pad bottom) through spray ring from HV-CA1-12 (system boundary)			H-2-98988, Sheet 1 of 1						HV-CA1-12 (system boundary) or at flange (input is not a waste)
No test (FRW)	1" FRW-658-M9	Filtered raw water				to unidentified nozzles (C-A-1) (4 typical) (upper deentrainment pad / upper pad bottom) through spray ring from HV-CA1-13 (system boundary)			H-2-98988, Sheet 1 of 1						HV-CA1-13 (system boundary) or at flange (input is not a waste)
No test (FRW)	1" FRW-665-M9	Filtered raw water				to unidentified nozzles (C-A-1) (4 typical) (lower deentrainment pad / lower pad top) through spray ring HV-CA1-14 (system boundary)			H-2-98988, Sheet 1 of 1						HV-CA1-14 (system boundary) or at flange (input is not a waste)
No test (FRW)	¾" AF-301-M9	antifoam				to unidentified nozzle or flange (C-A-1) from Pump P-E-102 (antifoam) (system boundary)			H-2-98988, Sheet 1 of 1						Pump P-E-102 (system boundary) or at flange (input is not a waste)
No test (FRW)	1" FRW-668-M9	filtered raw water				to unidentified nozzles (C-A-1) (4 typical) from filtered raw water HDR			H-2-98988, Sheet 1 of 1						Boundary at unidentified flange? No valve shown or ID on P&ID d/s of this line. Input is not a waste.
No test (FRW)	1" FRW-663-M9	filtered raw water				to unidentified nozzle or flange (C-A-1) (lower pad bottom) from HV-CA1-15 (system boundary)			H-2-98988, Sheet 1 of 1						HV-CA1-15 (system boundary) or at flange (input is not waste).
No test (FRW)	1" FRW-659-M9	filtered raw water				to unidentified nozzles (C-A-1) (4 typical) (upper pad top) from HV-CA1-13 (system boundary)			H-2-98988, Sheet 1 of 1						HV-CA1-13 (system boundary) or at flange (input is not a waste)
No test (FRW)	1" FRW-660-M9	filtered raw water				to unidentified nozzles (C-A-1) (4 typical) (upper pad top) from HV-CA1-12 (system boundary)			H-2-98988, Sheet 1 of 1						HV-CA1-12 (system boundary) or at flange (input is not a waste)
No test (FRW)	1" FRW-661-M9	filtered raw water				to unidentified nozzles (C-A-1) (4 typical) (upper pad top) from HV-CA1-11 (system boundary)			H-2-98988, Sheet 1 of 1						HV-CA1-11 (system boundary) or at flange (input is not a waste)
No test (FRW)	1" FRW-662-M9	filtered raw water				to unidentified nozzles (C-A-1) (4 typical) (upper pad top) from HV-CA1-11 (system boundary)			H-2-98988, Sheet 1 of 1						HV-CA1-10 (system boundary) or at flange (input is not a waste)
No test (FRW)	3/8" FRW-M31	Filtered raw water				from manifold to 509, 510, 511, 512, 513, and 5-116 (inputs into flanges (D through H, C-A-1)	SCH 40S, SS		H-2-98988, Sheet 1 of 1						509, 510, 511, 512, 513, and 5-116
No test (IA-STM-FRW)	½" I-CAI-M9	FRW, steam, and air				from 5-109 to C-A-1 (G)	0.035" thick SS		H-2-98988, Sheet 1 of 1						5-109
No test (IA-STM-FRW)	½" I-CAI-M9	FRW, steam, and air				from 5-110 to C-A-1 (E)	0.035" thick SS		H-2-98988, Sheet 1 of 1						5-110
No test (IA-STM-FRW)	¾" I-CAI-M9	FRW, steam, and air				from 5-111 to C-A-1 (F)	0.035" thick SS		H-2-98988, Sheet 1 of 1						5-111
No test (IA-STM-FRW)	½" I-CAI-M9	FRW, steam, and air				from 5-112 to C-A-1 (D)	0.035" thick SS		H-2-98988, Sheet 1 of 1						5-112
No test (IA-FRW)	¼" I-CA1-3-M9	FRW & air				from valve 5-113 to flange C (of C-A-1)			H-2-98988, Sheet 1 of 1						5-113
No test (IA-FRW)	½" I-CA1-2-M9	FRW & air				from valve 5-114 to flange B (of C-A-1)			H-2-98988, Sheet 1 of 1						5-114
No test (IA-FRW)	¼" I-CA1-1-M9	FRW & air				from valve 5-115 to flange A (of C-A-1)			H-2-98988, Sheet 1 of 1						5-115
No test (INSTR)	TE CA1-6	temperature indicator				to C-A-1			H-2-98988, Sheet 1 of 1						
No Test (SC)	to 4" SC-500-M9	steam condensate				4" SC-500-M9 (steam condensate subsystem) from E-A-1 (unidentified flange/nozzle)			H-2-98988, Sheet 2 of 2						System Boundary
No Test (SL)	3" SL-130-M9					from nozzle B (on 28" Recirculation Line) through UE CA1-3 (300 gpm) to nozzle or flange G to HV-F2-3	SCH 10S, SS (heat traced, insulated)	HT/INS	H-2-98989						
No Test (SL)	3" SL-130-M9	Sample line (SAMP-F-2)				from HV-F2-3 to Samp-F-2	SCH 10S, SS (heat traced, insulated)		H-2-98989						
No test (INSTR)	RTD TE CA1-7	Temperature indicator				to 3"SL-130-M9 between nozzle B and nozzle or flange G			H-2-98989						
No test (INSTR)	TC/TI SMPL-2	Temperature indicator				to 3"SL-130-M9 (heat tracing) between nozzle or flange G and HV-F2-3		HT	H-2-98989						

Attachment B-1
(Vapor-Liquid Separator and Ancillary Equipment)

Test	Component ID	Description	Isolation Point	Isolation from (component)	Item to be Photographed	Line Segment Description	Specifications / Materials of Construction	Accessibility / Insulated	P&ID	Maximim/Design Values		Operating Values		Test Pressure	Comments
										Flow/Pressure	Temperature	Operating	Temperature		
No Test (SAMP)	SAMP-F-2					Sampler			H-2-98989						
No Test (DR)	1" DR-M9	Drain system				from HV-F2-4 to just upstream of HV-F2-3	SCH 10S, SS		H-2-98989						Valve HV-F2-4 System Boundary (to Drain system)
No Test (RW)	1" RW-M9	Raw Water System				from HV-F2-5 to just upstream of HV-F2-3	SCH 10S, SS		H-2-98989						Valve HV-F2-5 System Boundary (to RW subsystem)
No Test (RW)	½" RW-M9,	Raw Water System				from HV-F2-1 to SAMP-F-2	SCH 40S, SS		H-2-98989						Valve HV-F2-1 System Boundary (RW)
No Test (SL)	½" SL-131-M9	Slurry - Sample line (SAMP-F-2)				to HV-F2-6 from SAMP-F-2	SCH 10S, SS		H-2-98989						HV-F2-6 System Boundary (DR / Sample Bottle)
No Test (RW)	1" RW-M9	Raw Water System				from HV-F2-2 to 3" SL-130-M9 (just downstream of SAMP-F-2)	SCH 10S, SS		H-2-98989						
No Test (SL)	3" SL-130-M9	Slurry - Sample line (SAMP-F-2)				from Samp-F-2 to nozzle or flange H to nozzle A (on 28" Recirculation Line)	SCH 10S, SS (heat traced, insulated)	HT/INS	H-2-98989 / H-2-98988, Sheet 2 of 2						
No Test (IA-FRW-STM)	½" I-CAI-8-M9	FRW, steam, and air				from 5-116 to flange H (28" Recirculation line)	0.035" thick, SS		H-2-98988, Sheet 1 of 1						5-116
No Test (INSTR)	TE EA1-1	Temperature Indicator				to 28" recirc line (between E-A-1 & C-A-1)			H-2-98988, Sheet 2 of 2						
No Test (INSTR)	PE EA1-2	Pressure Indicator				to 28" recirc line (between E-A-1 & C-A-1)			H-2-98988, Sheet 2 of 2						
No Test (STM)	18" STM (10 PSIG) 470-M9	Steam				to unindentified flange, 28" recirc line from FV-EA1-1 at upstream end of E-A-1			H-2-98988, Sheet 2 of 2						At flange or d/s Iso / CV (not shown on P&ID)
No Test (INSTR)	PE EA1-12	Pressure Indicator				to 28" recirc line (upstream end of E-A-1)			H-2-98988, Sheet 2 of 2						
No Test (INSTR)	TE EA1-7	Temperature Indicator				to 28" recirc line (upstream end of E-A-1)			H-2-98988, Sheet 2 of 2						
No Test (INSTR)	FE CA1-7	Flow Indicator				to 28" recirc line at flange/nozzle E (upstream end of P-B-1)			H-2-98988, Sheet 2 of 2						
No Test (FEED)	3" SN-25I-M9	Recirc - Sample line (SAMP-F-1)				(Heat traced and insulated from K to F-1) from nozzle 13 to SAMP-F-I, through flange or nozzle K	SCH 10S, SS	INS	H-2-98988, Sheet 2 of 2						
No Test (FEED)	SAMP-F-1					Sampler			H-2-98988, Sheet 2 of 2						
No Test (FEED)	¾" SN-250-M9	Recirc - Sample line (SAMP-F-1)				from HV-FI-2 to SAMP-F-1	SCH I0S, SS		H-2-98988, Sheet 2 of 2						
No Test (FEED)	¾" SN-250-M9	Recirc - Sample line (SAMP-F-1)				from HV-FI-2 to SAMP-F-1	SCH I0S, SS		H-2-98988, Sheet 2 of 2						
No Test (FEED)	½" RW-M9	Raw Water System				from HV-F1-1 to SAMP-F-1	SCH 40, SS		H-2-98988, Sheet 2 of 2						
No Test (FEED)	3" SN-251-M9	Recirc - Sample line (SAMP-F-1)				from SAMP-F-1 through flange or nozzle J, through flange or nozzle 13A, through FE CA1-1 to HV-CA1-1 to Nozzle D	SCH I0S, SS		H-2-98988, Sheet 2 of 2						
No Test (FEED)	¾" SN-250-M9	Recirc - Sample line (SAMP-F-1)				from HV-F1-2 to sample bottle	SCH I0S, SS		H-2-98988, Sheet 2 of 2						
No Test (SL)	3" SL-M9	Slurry				from nozzle C (28" line), past HV-CAI-2 and HV-CA1-2A to P-B-2 inlet	SCH 10S, SS		H-2-98989 / H-2-98988, Sheet 2 of 2						
No test (SL)	P-B-2	Bottoms Pump					Variable speed, max. capacity 125 gpm, mechanical seals: 316 SS, shaft 316 SS, impeller and casing: CD4MCU		H-2-98989	Not Specified					
No test (SL)	2" SL-M9	Slurry				from P-B-2 outlet, past 2" Spool or HV-CA1-3 (when installed) to HV-CA1-5	SCH 10S, SS		H-2-98989						
No test (SL)	2" SL-M9	Slurry				From HV-CA1-5 through flange or nozzle 5 to nozzle 19	SCH 10S, SS		H-2-98989						Nozzle 19 system boundary
No test (SL)	2" SL-M9	Slurry				From HV-CA1-5 through flange or nozzle 4 to nozzle 18 (alternate jumper)	SCH 10S, SS		H-2-98989						Nozzle 18 system boundary
No test (SL)	2" SL-M9	Slurry				from PSV-PB2-1 to 2" SL (upstream of HV-CA1-3) through HV-PB2-1	SCH 10S, SS		H-2-98989						HV-PB2-1 system boundary (DR)
No Test (DR)	6" DR-335-M9	Drain system				from ?? Flange or nozzle (evaporator drop-part of System 7, Line 7.32) from 28" recirculation line, past HV-CA1-7 to HV-CA1-9	SCH 10S, SS		H-2-98989						
No Test (U)	2" U-850-M9	Flush water(?)				(flush line) from 5-47 through flange or valves 5 and 10, to HV-CA1-2 and HV-CA1-2A from flush valve HV-CA1-8	SCH 10S, SS		H-2-98989						

Attachment B-2
(Condensate Collection Tank and Ancillary Equipment)

Test	Component ID	Description	Isolation Point	Isolation from (component)	Item to be Photographed	Line Segment Description	Specifications / Materials of Construction	Accessibility / Insulated	P&ID	Maximim/Design Values		Operating Values		Test Pressure	Comments / System Boundary
										Flow/Pressure	Temperature	Operating	Temperature		
Leak Test (Condensate Tank)															
TKC100 Leak Test	TK-C-100	CONDENSATE COLLECTION TANK	NA (Tank)	NA (Tank)	TK-C-100	NA (Tank)	14' OD X 19' 9 7/8" tall x 5/16" thick, 17,800 gal 347 and 304L SS.	Not insulated/Accessible	H-2-98990, SH1	5 psig	145°F	14.7 psia	80 - 110°F		
TKC100 Leak Test	TK-C-100	CONDENSATE COLLECTION TANK	NA (no connection at flange)	NA (no connection at flange)	Flange W	Flange W	14' OD X 19' 9 7/8" tall x 5/16" thick, 17,800 gal 347 and 304L SS.	Not insulated/Accessible	H-2-98990, SH1	5 psig	145°F	14.7 psia	80 - 110°F		No connection at flange (i.e. no input or extraction fluids or vapors from system at this point); however, if leaks are observed, replacing gasketing or flange cover may be req'd.
TKC100 Leak Test	TK-C-100	CONDENSATE COLLECTION TANK	NA (no connection at flange)	NA (no connection at flange)	Flange M	Flange M	14' OD X 19' 9 7/8" tall x 5/16" thick, 17,800 gal 347 and 304L SS.	Not insulated/Accessible	H-2-98990, SH1	5 psig	145°F	14.7 psia	80 - 110°F		No connection at flange (i.e. no input or extraction fluids or vapors from system at this point); however, if leaks are observed, replacing gasketing or flange cover may be req'd.
TKC100 Leak Test	TK-C-100	CONDENSATE COLLECTION TANK	NA (instrument connection)	TE C100-1	Flange Y	Flange Y (TK-C-100) to TE C100-1	14' OD X 19' 9 7/8" tall x 5/16" thick, 17,800 gal 347 and 304L SS.	Not insulated/Accessible	H-2-98990, SH1	5 psig	145°F	14.7 psia	80 - 110°F		Instrument does not input or extract fluids or vapors from system; however, if leaks are observed, blanking at flange and/or replacing gasketing may be req'd.
TKC100 Leak Test	TK-C-100	CONDENSATE COLLECTION TANK	NA (instrument connection)	FIC C100-1, 2, 3, 4; WFT C100-1; LT C100 1, 2 (Lines are required for level indication)	Flange H	Flange H: FIC C100-1, 2, 3, 4; WFT C100-1; LTC100-1	14' OD X 19' 9 7/8" tall x 5/16" thick, 17,800 gal 347 and 304L SS.	Not insulated/Accessible	H-2-98990, SH1	5 psig	145°F	14.7 psia	80 - 110°F		Instrument does not input or extract fluids or vapors from system; however, if leaks are observed, blanking at flange and/or replacing gasketing may be req'd.
TKC100 Leak Test	TK-C-100	CONDENSATE COLLECTION TANK	N/A, vent line which is above liquid level during leak test	2" V -1209-M42		from TK-C-103, H-2-98993, (Flange J) to TK-C-100 (Flange R)	14' OD X 19' 9 7/8" tall x 5/16" thick, 17,800 gal 347 and 304L SS.	Not insulated/Accessible	H-2-98990, SH1	5 psig	145°F	14.7 psia	80 - 110°F		No isolation valve shown on H-2-98990 between tanks
TKC100 Leak Test	TK-C-100	CONDENSATE COLLECTION TANK	N/A, vent line which is above liquid level during leak test	4" VV-1000-M42		from TK-C-100 (Flange C),	14' OD X 19' 9 7/8" tall x 5/16" thick, 17,800 gal 347 and 304L SS.	Not insulated/Accessible	H-2-98990, SH1 / H-2-98998	5 psig	145°F	14.7 psia	80 - 110°F		No isolation valve shown on H-2-98990 for line. Continues to H-2-98998.
TKC100 Leak Test	TK-C-100	CONDENSATE COLLECTION TANK	N/A, tank agitator connection which is above liquied level during leak test	Flange T (TK-C-100)		Flange T: A-C100 agitator	14' OD X 19' 9 7/8" tall x 5/16" thick, 17,800 gal 347 and 304L SS.	Not insulated/Accessible	H-2-98990, SH1	5 psig	145°F	14.7 psia	80 - 110°F		Motor / agitator does not input or extract fluids or vapors from system; however, if leaks are observed, blanking at flange and/or replacing gasketing may be req'd.
TKC100 Leak Test	TK-C-100	CONDENSATE COLLECTION TANK	Valves 2B-1 & 2B-2 in 3/4" DECON-816-M9	¾" Decon-816-M9	Flange N	¾" Decon-816-M9 from 2" Decon-801-M9 to Flange N of TK-C-100	14' OD X 19' 9 7/8" tall x 5/16" thick, 17,800 gal 347 and 304L SS.	Not insulated/Accessible	H-2-98990, SH1	5 psig	145°F	14.7 psia	80 - 110°F		No CV / isolation valve shown on line on H-2-98990. Line continues on H-2-98996.
TKC100 Leak Test	TK-C-100	CONDENSATE COLLECTION TANK	Valves 3-25 and 3-26 in 4" PC-550-M42.	4" PC-550-M42	Flange U; Valves 3-35 and 3-26 of PC-560-M42	(E-C-1) through FIT EC1-2 and isolation valves 3-24 and 3-25, to TK-C-100 (Flange U). Note: Both overflow lines are routed to 2" floor drain via flex hose.	14' OD X 19' 9 7/8" tall x 5/16" thick, 17,800 gal 347 and 304L SS.	Not insulated/Accessible	H-2-98990, SH1	5 psig	145°F	14.7 psia	80 - 110°F		Prevents inadvertent addition of liquid to tank during leak test
TKC100 Leak Test	TK-C-100	CONDENSATE COLLECTION TANK	Valve 4-24 of ¾" PC-551-M42	¾" PC-551-M42	Flange S; Valve 4-24 of ¾" PC-551-M42	from 4-24 (E-C-2) to TK-C-100 (Flange S)	14' OD X 19' 9 7/8" tall x 5/16" thick, 17,800 gal 347 and 304L SS.	Not insulated/Accessible	H-2-98990 / H-2-98999	5 psig	145°F	14.7 psia	80 - 110°F		Prevents inadvertent addition of liquid to tank during leak test
TKC100 Leak Test	TK-C-100	CONDENSATE COLLECTION TANK	Valve 2C-4 in 1 1/2" PC-553-M42	1½" PC-553-M42	Flange A; Flange F; Valve 2C-4 in 1 1/2" PC-553-M42	1½" PC-553-M42 from seal pot Flange B and Flange A (through 2C-4) to TK-C-100 (Flange F)	14' OD X 19' 9 7/8" tall x 5/16" thick, 17,800 gal 347 and 304L SS.	Not insulated/Accessible	H-2-98990, SH1	5 psig	145°F	14.7 psia	80 - 110°F		Verify Seal Pot is empty at start of leak test and monitor level during leak test
TKC100 Leak Test	TK-C-100	CONDENSATE COLLECTION TANK	Valve 4-23 of ¾" PC-552-M42	¾" PC-552-M42	Flange L; Valve 4-23 of ¾" PC-552-M42	from 4-23 (E-C-3) to TK-C-100 (Flange L)	14' OD X 19' 9 7/8" tall x 5/16" thick, 17,800 gal 347 and 304L SS.	Not insulated/Accessible	H-2-98990, SH1	5 psig	145°F	14.7 psia	80 - 110°F		Prevents inadvertent addition of liquid to tank during leak test
TKC100 Leak Test	TK-C-100	CONDENSATE COLLECTION TANK	Valve 2-32 of 2" PC-554-M9	2"Flex	Flange Z; Valve 2-32 of 2" PC-554-M9	from 2" PC-554-M9 to flange Z (TK-C-100)	14' OD X 19' 9 7/8" tall x 5/16" thick, 17,800 gal 347 and 304L SS.	Not insulated/Accessible	H-2-98990, SH1	5 psig	145°F	14.7 psia	80 - 110°F		Prevents inadvertent addition of liquid to tank during leak test
TKC100 Leak Test	TK-C-100	CONDENSATE COLLECTION TANK	Valve 1-16 in 3" PC-558-M42	3" PC-558-M42	Flange B; Valve 1-16 in 3" PC-558-M42	from HV-RC3-3 (divert), through 1-16, to TK-C-100 (Flange B)	14' OD X 19' 9 7/8" tall x 5/16" thick, 17,800 gal 347 and 304L SS.	Not insulated/Accessible	H-2-98990, SH1	5 psig	145°F	14.7 psia	80 - 110°F		Prevents inadvertent addition of liquid to tank during leak test
TKC100 Leak Test	TK-C-100	CONDENSATE COLLECTION TANK	Valves 2-43 of 1" PC SAMPLE RETURN and HV-RC3-1 of 1/2" PC SAMPLE BYPASS RETURN (in NORMAL position)	1" PC SAMPLE RETURN / 1/2" PC SAMPLE BYPASS RETURN	Flange E; Valves 2-43 of 1" PC SAMPLE RETURN and HV-RC3 1 of 1/2" PC SAMPLE BYPASS RETURN (in NORMAL position)	SST from FIAS – RC3-1 to TK-C-100 (Flange E)	14' OD X 19' 9 7/8" tall x 5/16" thick, 17,800 gal 347 and 304L SS.	Not insulated/Accessible	H-2-98990, SH1 / H-98990, SH2	5 psig	145°F	14.7 psia	80 - 110°F		Prevents inadvertent addition of liquid to tank during leak test
TKC100 Leak Test	TK-C-100	CONDENSATE COLLECTION TANK	N/A 2" -VE-1059-M9 is from outlet of SRV-1 off of 3" PC-557-M9 which will not be pressurized during leak test	2"-VE-1059-M9		2"-VE-1059-M9 from SRV-1 to nozzle J of TK-C-100	14' OD X 19' 9 7/8" tall x 5/16" thick, 17,800 gal 347 and 304L SS.	Not insulated/Accessible	H-2-98990, SH1 / H-2-88766, SH1	5 psig	145°F	14.7 psia	80 - 110°F		SRV-1 on H-2-88766, SH1 (set at 65 psig), bypass? to VB-C-1. Drain w/out iso / CV prior to SRV-1 (1/4"DR-1050-M9)
TKC100 Leak Test	TK-C-100	CONDENSATE COLLECTION TANK	N/A 3" OVFL-1801-M42 is TK-C-100 overflow and level will established below this lin	3" OVFL-1801-M42		Seal loop / level gauge - from flange G (TK-C-100) through seal loop to 3" DR-359-M24 (code change from M42 to M24).	14' OD X 19' 9 7/8" tall x 5/16" thick, 17,800 gal 347 and 304L SS.	Not insulated/Accessible	H-2-98990, SH1 / H-2-98996	5 psig	145°F	14.7 psia	80 - 110°F		Verify valve 1-2 at bottom of seal loop is closed and monitor seal loop level during leak test
TKC100 Leak Test	TK-C-100	CONDENSATE COLLECTION TANK	PCV-CA1-10	1" PCR-751-M42	Flange P; PCV-CA1-10	From PCV-CA1-10 to Flange P of TK-C-100	14' OD X 19' 9 7/8" tall x 5/16" thick, 17,800 gal 347 and 304L SS.	Not insulated/Accessible	H-2-98990, SH1 / H-2-99083	5 psig	145°F	14.7 psia	80 - 110°F		Verify P-C100 is not running during leak test

Attachment B-2
(Condensate Collection Tank and Ancillary Equipment)

Test	Component ID	Description	Isolation Point	Isolation from (component)	Item to be Photographed	Line Segment Description	Specifications / Materials of Construction	Accessibility / Insulated	P&ID	Maximin/Design Values		Operating Values		Test Pressure	Comments / System Boundary
										Flow/Pressure	Temperature	Operating	Temperature		
TKC100 Leak Test	TK-C-100	CONDENSATE COLLECTION TANK	Valves 1-91, 1-92 in 2" PCR-750-M42	Unidentified from 1-91, 1-92 to flange K	Flange K; Valves 1-91, 1-92 in 2" PCR-750-M42	Unidentified from 1-91, 1-92 to flange K	14' OD X 19' 9 7/8" tall x 5/16" thick, 17,800 gal 347 and 304L SS.	Not insulated/Accessible	H-2-98990, SH1	5 psig	145°F	14.7 psia	80 - 110°F		Verify P-C106 is not running during leak test
TKC100 Leak Test	TK-C-100	CONDENSATE COLLECTION TANK	Valves 1-3 and 1-3A	3" DR-359-M42	Flange V; Valves 1-3 and 1-3A	3" DR-359-M42 from TK-C-100 (Flange V), through 1-3A, code change to M24, to 6" DR-343-M2	14' OD X 19' 9 7/8" tall x 5/16" thick, 17,800 gal 347 and 304L SS.	Not insulated/Accessible	H-2-98990, SH1	5 psig	145°F	14.7 psia	80 - 110°F		1-3A
TKC100 Leak Test	2" PC-562-M42	PC	NA - pump, line and tank included in leak test	NA - pump, line and tank included in leak test		from TK-C-100 (Flange A), through 1-8, to pump P-C100 inlet	SCH 40, CS, CS/SS	Not insulated/Accessible	H-2-98990, SH1						
TKC100 Leak Test	P-C100	CONDENSATE PUMP	Valve 1-9 on 1 1/2" PC PC-554-M42	2" PC-554-M42	P-C100	pump	Standard end section, single stage, centrifugal pump. CS shaft and impeller with SS shaft sleeve. 10 hp/3,500 RPM motor, capacity is 50 gpm at 110' head.	Not insulated/Accessible	H-2-98990, SH1						
Ancilliary Equipment															
No Test (AE)	SEAL POT, LIQUID SEAL						18" OD x 24" deep SCH 40 CS pipe		H-2-98990, SH1	Atmospheric					
No Test (AE)	RC-3	RADIATION MONITOR - Standard scintillation radiation monitor for gamma detection.							H-2-98990, SH1						
No Test (PC)	4" PC-550-M42	PC				(E-C-1) through FIT EC1-2 and isolation valves 3-24 and 3-25, to TK-C-100 (Flange U). Note: Both overflow lines are routed to 2" floor drain via flex hose.	SCH 40, CS, CS/SS		H-2-98990, SH1						3-24, 3-26
No Test (PC)	4" PC-550-M42	PC				Bypass to FIT EC1-2 through 3-26 (NC).	SCH 40, CS, CS/SS		H-2-98990, SH1						3-24, 3-26
No Test (PC)	1"V-1203-M42					from 4" PC-550-M42 to 3" V-1202-M42	SCH 40 CS		H-2-98990, SH1						no iso / CV on this line between PC and VC systems (are now considered same subsystem)
No Test (INSTR)	TE EC1-2	Temperature indicator				after 3-24, 3-26			H-2-98990, SH1						
No Test (PC)	¼" PC-551-M42	PC				from 4-24 (E-C-2) to TK-C-100 (Flange S)	SCH 40, CS, CS/SS		H-2-98990, SH1						4-24 is only valve shown between TK-C-100 & E-C-2
No Test (PC)	¼" PC-552-M42	PC				from 4-23 (E-C-3) to TK-C-100 (Flange L)	SCH 40, CS, CS/SS		H-2-98990, SH1						4-23 is only valve shown between TK-C-100 & E-C-2
No Test (vent)	2" V-1209-M42					from TK-C-103, H-2-98993, (Flange J) to TK-C-100 (Flange R)	SCH 40, CS, CS/SS		H-2-98990, SH1						No isolation valve shown on H-2-98990 between tanks
No Test (VV)	4" VV-1000-M42					from TK-C-100 (Flange C).	SCH 40, CS	Heat traced from valve 2C-5 to branch to 4"VV-AIR INTAKE-M42 and along this line to damper 3-1 (H-2-98998)	H-2-98990, SH1 / H-2-98998						No isolation valve shown on H-2-98990 for line. Continues to H-2-98998.
No Test (PC SR)	1" PC SAMPLE RETURN	PC				SST from FIAS – RC3-1 to TK-C-100 (Flange E)	SST		H-2-98990, SH1 & SH2						No isolation valve shown on H-2-98990 for line. Continues to H-2-98990, SH2.
No Test (PC SR)	1/2" PC SAMPLE BYPASS RETURN	PC				From HV-RC3-1 (divert) to 1" PC SAMPLE RETURN	M31 / SS		H-2-98990, SH1 & SH2						No isolation valve shown on H-2-98990 for line. Continues to H-2-98990, SH2.
No Test (INSTR)	Unknown ¼" line	Pressure tap				thru 1-9A to PI C100-2			H-2-98990, SH1						
No Test (PC)	P-C100	CONDENSATE PUMP (see above)							H-2-98990, SH1						
No Test (AE)	2" PC-554-M42	PC				from unidentified check valve to FIT-C100-5, isolated by valves 2-30 and 2-28	SCH 40, CS		H-2-98990, SH1						
No Test (AE)	2" PC-554-M42	PC				Bypass to FIT-C100-5 through vavle 2-29 (NC)			H-2-98990, SH1						
No Test (AE)	½" DR 378 M42	PC drain				from 2" PC-554-M42 main and FIT-C100-5 by pass	SCH 40, CS		H-2-98990, SH1						
No Test (AE)	2" PC-554-M42	PC				From FIT-C100-5 to FC / FV-C100-5 isolated by valves 2-26 and 2-24	SCH 40, CS		H-2-98990, SH1						
No Test (AE)	2" PC-554-M42	PC				Bypass to FC /E42 FV-C100-5 through valve 2-25 (NC)	SCH 40, CS		H-2-98990, SH1						
No Test (AE)	2" PC-554-M42	PC				From FC / FV-C100-5 to F-C-1 (condensate filter) isolated by valves 1-12 and 1-15	SCH 40, CS		H-2-98990, SH1						
No Test (AE)	F-C-1	Condensate Filter							H-2-98990, SH1						
No Test (AE)	2" PC-554-M42	PC				From FC / FV-C100-5 to valve 1-11 (F-C-1 bypass NC)	SCH 40, CS		H-2-98990, SH1						
No Test (AE)	¼" I-FC1-5-M31	Pressure tap				to Valve 1-12A to PT FC1-3 & PI FC-1			H-2-98990, SH1						Pressure indicators are isolated by 1-12A
No Test (AE)	¼" I-FC1-4-M31	Pressure tap				to Valve 1-15A to PT FC1-2 & PI FC-4			H-2-98990, SH1						Pressure indicators are isolated by 1-15A

Attachment B-2
(Condensate Collection Tank and Ancillary Equipment)

Test	Component ID	Description	Isolation Point	Isolation from (component)	Item to be Photographed	Line Segment Description	Specifications / Materials of Construction	Accessibility / Insulated	P&ID	Maximim/Design Values		Operating Values		Test Pressure	Comments / System Boundary
										Flow/Pressure	Temperature	Operating	Temperature		
No Test (AE)	2" PC-554-M42	PC				From F-C-1 to valve 2-33	SCH 40, CS		H-2-98990, SH1						
No Test (AE)	½" VENT-OM42	PC				from F-C-1, through 1-13A, to 3" DR-380-M24 (drain funnel)	SCH 80, CS		H-2-98990, SH1						1-13A
No Test (AE)	½" DR-349-M42	PC				through 1-13 (FRM F-C-1) to 3" DR-380-M24 (DRAIN FUNNEL)			H-2-98990, SH1						1-13
No Test (AE)	2" RW-612-M4	RW				From Valve 2-36 to 2" PC-564-M42			H-2-98990, SH1						2-35
No Test (AE)	2" EL-901-M-42					From Valve 2-36 to 2" PC-564-M42			H-2-98990, SH1						2-36
No Test (AE)	2" PC-554-M42	PC				from 2-33 through unidentified pipe flange to valve 1-29	SCH 40, CS		SCH 40, CS						
No Test (AE)	2" PC-554-M42	PC				from valve 1-29 to unidentified pipe flange (EOL at flange?) to 2" PC-559-M42 (start line at flange)	SCH 40, CS		H-2-98990, SH1						
No Test (AE)	2" PC-554-M42	PC				to valve 2-32 from valve 1-29	SCH 40, CS		H-2-98990, SH1						
No Test (AE)	2" PC-554-M9	PC				from valve 2-32 to flex line (schedule change from M42 to M9)	SCH 40, CS		H-2-98990, SH1						
No Test (PC)	2"Flex	PC				from 2" PC-554-M9 to flange Z (TK-C-100)			H-2-98990, SH1						
No Test (AE)	F-C-3	Duplex Filter							H-2-98990, SH1						
No Test (AE)	2" PC-559-M42	PC				from unidentified pipe flange / 2" PC554 M42 to Duplex Filter F-C-3 isolated by valves 2-28 and 2-40	SCH 40, CS (assumed)		H-2-98990, SH1						
No Test (AE)	¼" HLS-4-M31	Pressure tap				to WS2-60 F2-49 & PI-ILS-1 & PSH ILF-1 & PT-ILS-5 before F-C-3			H-2-98990, SH1						Pressure indicators are isolated by valves 2-49 and 2-50
No Test (AE)	½" DR-M42	F-C-3 Drain line				F-C-3 to ½" DR thru 2-40C to Drain Pan to 2" DR-382-M2 drain funnel	SCH 40 CS		H-2-98990, SH1						2-40C
No Test (AE)	2" PC-599	PC				Bypass to F-C-3 through valve 2-39	SCH 40, CS (assumed)		H-2-98990, SH1						
No Test (AE)	½" HLS-6-M31	Pressure tap				thru Valve 2-51 to PI ILS-2 & PT ILS-6			H-2-98990, SH1						Pressure indicators are isolated by viave 2-51
No Test (AE)	2" PC-556-M42	PC				from 2" PC-554-M42 to valve 1-28	SCH 40, CS		H-2-98990, SH1						
No Test (AE)	2" PC-556-M42	PC				from valve 1-28 to FE RC3-1	SCH 40, CS		H-2-98990, SH1						
No Test (AE)	2" PC-556-M42	PC				from FE RC3-1 to PCV RC3-1 isolated by valves 1-21 and 1-18	SCH 40, CS		H-2-98990, SH1						
No Test (AE)	2" PC-556-M42	PC				Bypass to PCV RC3-1 through valve 1-19	SCH 40, CS		H-2-98990, SH1						
No Test (AE)	Unidentified p-tap line to PI PC-1	Pressure tap				Pressure tap to bypass loop to PCV RC3-1			H-2-98990, SH1						PI is isolated by 1-54
No Test (AE)	Unidentified p-tap line to PI PC-2	Pressure tap				Pressure tap to bypass loop to PCV RC3-1			H-2-98990, SH1						PI is isolated by 1-55
No Test (AE)	Unidentified p-tap line to PI PC-3	Pressure tap				Pressure tap to bypass loop to PCV RC3-1			H-2-98990, SH1						PI is isolated by 1-56
No Test (AE)	2" PC-556-M42	PC				from PCV RC3-1 to HV RC3-3	SCH 40, CS		H-2-98990, SH1						
No Test (PC)	3" PC-556-M42	PC				from HV-RC3-3 (divert), through 1-16, to TK-C-100 (Flange B)	SCH 40, SS, CS/SS		H-2-98990, SH1						
No Test (AE)	3" DR-338-M42	drain				from 3" PC-556-M42 (Downstream of HV-RC3-3) to 1-17	SCH 40, CS		H-2-98990, SH1						1-17
No Test (AE)	3" DR-338-M42	DR				from valve 1-17, change to M24 to 3" DR-338-M24 to TK-241-AW-102, via DR-334-M25	SCH 40, CS		H-2-98990, SH1						
No Test (AE)	3" PC-557-M42	PC				3" PC-557-M42 from HV-RC3-3 to 3" PC-557-M9 (schedule change?)	SCH 40, CS		H-2-98990, SH1						HV-80W-001 is first valve shown after HV-RC3-3 (on PC5000 line). See P&ID H-2-88768, SH1
No Test (AE)	2" PC-559-M42	PC				2" PC-559-M42 from SAMP-RC3-1 through 1-27 to 2" PC-556-M42 (just downstream of 1-28)	SCH 40, CS		H-2-98990, SH1						
No Test (AE)	½" DR-M42	PC sample				½" DR-M42 (sample) from 2" PC-556-M42 (upstream of FE- RC3-1) to 1-26A	SCH 80 CS		H-2-98990, SH1 / H-2-98996						1-26A / 1-26
No Test (AE)	½" DR-M42	PC sample				½" DR-M42 from 1-26A to 1-26, pipe code change at 1-26 from M42 to M9; 1/2"DR-M31 from 1-26 to 2" DR-382-M2 drain funnel.	SCH 80 CS		H-2-98996						1-26A / 1-26
No Test (AE)	2" PC – Sample drain	PC sample drain (RC-3)				2" PC – Sample drain from RC-3 to 3" DR-371-M24 Floor Drain.	Pipe code not specified. Assume to be SS.		H-2-98990, SH2 / H-2-98996						
No Test (UNID)	Unidesignated line from PCV-CA1-10					From PCV-CA1-10 to Flange P of TK-C-100			H-2-98990, SH1 / H-2-99083						PCV-CA1-10
No Test (PC)	2"-VE-1059-M9	vent				2"-VE-1059-M9 from SRV-1 to nozzle J of TK-C-100			H-2-98990, SH1 / H-2-88766, SH1						SRV-1 on H-2-88766, SH1 (set at 65 psig). bypass? to VB-C-1. Drain w/out iso / CV prior to SRV-1 (1/4"DR-1050-M9)

Attachment B-2
(Condensate Collection Tank and Ancillary Equipment)

Test	Component ID	Description	Isolation Point	Isolation from (component)	Item to be Photographed	Line Segment Description	Specifications / Materials of Construction	Accessibility / Insulated	P&ID	Maximim/Design Values		Operating Values		Test Pressure	Comments / System Boundary
										Flow/Pressure	Temperature	Operating	Temperature		
No Test (PC)	1½" PC-563-M42	PC				1½" PC-563-M42 from seal pot Flange B and Flange A (through 2C-4) to TK-C-100 (Flange F)	SCH 40, CS, CS/SS		H-2-98990, SH1						Flange F
No Test (DECON)	¼" Decon-816-M9					¼" Decon-816-M9 from 2" Decon-801-M9 to Flange N of TK-C-100			H-2-98990, SH1						No CV / isolation valve shown on line on H-2-98990. Line continues on H-2-98998.
2	Flange M (TK-C-100)	Flange				No connection			H-2-98990, SH1						No connection
2	Flange W (TK-C-100)	Flange				No connection			H-2-98990, SH1						No connection
No Test (M)	Flange T (TK-C-100)	Agitator				Flange T: A-C100 agitator			H-2-98990, SH1						Motor / agitator at flange
No Test (INSTR)	Flange H (TK-C-100)	Instrumentation				Flange H: FIC C100-1, 2, 3, 4; WFT C100-1; LTC100 1, 2			H-2-98990, SH1						instrumentation connected at flange
No Test (AE)	Seal Pot	See above							H-2-98990, SH1	Atmospheric					
No Test (AE)	1" DR-M42	drain				1" DR-M42 to nozzle E (Seal Pot) from F-C-5-1 (vessel vent system)			H-2-98990 / H-2-98998						No CV / isolation valve shown between seal pot and F-C-5-1 on this line.
No Test (AE)	¾" RW-520-M42	RW				to Flange F (Seal Pot) from 2" RW-512-M5 through Valve 2C-1			H-2-98990, SH1						2C-1
No Test (AE)	1" overflow M-42					1" overflow M41 40 to nozzle K (Seal Pot) from DU-C-1 (vessel vent system)			H-2-98990 / H-2-98998						No CV / isolation valve shown between seal pot and DU-C-1 on this line.
No Test (AE)	Unknown penetrations (Seal Pot)	Instrumentation				No flange shown: LSL/2YL LEL SP-1 through unknown penetration (Seal Pot)			H-2-98990, SH1						instrumentation
No Test (AE)	½" DR-337-M42	drain				½" DR-337-M42 to nozzle G (Seal Pot) from F-C-5-2			H-2-98990 / H-2-98998						No CV / isolation valve shown between seal pot and F-C-5-2 on this line.
No Test (AE)	½" DR-363-M42	drain				½" DR-363-M42 to nozzle H (Seal Pot) from EX-C-1 (vessel vent system)			H-2-98990 / H-2-98998						No CV / isolation valve shown between seal pot and EX-C-1 on this line.
No Test (AE)	1" DR-M42	drain				1" DR-M42 to nozzle J (Seal Pot) from F-E-5-2			H-2-98990 / H-2-98998						No CV / isolation valve shown between seal pot and F-C-5-2 on this line.
No Test (AE)	Flanges C & D (Seal Pot)	Instrumentation				LG loop thrugh valves 2C-2 & 2C-3 to Flanges C&D (Seal Pot)			H-2-98990, SH1						instrumentation connected at flange
No Test (INSTR)	TE C100-1	Instrumentation				Flange Y (TK-C-100) to TE C100-1			H-2-98990, SH1						instrumentation connected at flange
No Test (UNID)	Flange K (TK-C-100)	Unknown				Unidentified from 1-91, 1-92 to flange K			H-2-98990, SH1						1-91, 1-92
No Test (DR)	3" DR-359-M42	Drain				3" DR-359-M42 from TK-C-100 (Flange V), through 1-3A, code change to M24, to 6" DR-343-M2	SCH 40 CS		H-2-98990, SH1						1-3A
No Test (AE)	Unidentified line					from 3" DR-359-M42 through valve 1-3 to 1/2"PC-563-M42 (between 1-2 and 1-5).	SCH 40 CS (assumed)		H-2-98990, SH1						1-5
No Test (OVFL)	3" OVFL-1801-M42	Seal loop / level gauge				from flange G (TK-C-100) through seal loop to 3" DR-359-M24 (code change from M42 to M24).			H-2-98990, SH1 / H-2-98995						No CV / isolation valve shown between seal loop and end of drain line.
No Test (AE)	1/2" PC-563-M42	Sela loop drain				from seal loop to valve 1-2 to valve 1-5 to 2" DR-377-M24 / Drain Funnel.			H-2-98990, SH1						1-2

Attachment B-3

Test Procedure for Visual Examination

1.0 SCOPE

This attachment contains methods and requirements for visual examination applicable to non-destructive examinations, leak testing, and in-service examinations of 242-A Evaporator System components. The list of components to be visually inspected or examined is provided in Attachment B-1.

2.0 PERSONNEL REQUIREMENTS

Personnel performing visual examination shall be qualified to a nationally recognized certification program. Visual examination shall be performed by Level II QC inspectors who are certified to perform examinations in accordance with ASME Section XI (VT-2), Division 1, Class 3 (2001), IWA-5240 "Visual Examination" (VT-2).

3.0 EQUIPMENT

Equipment used for visual examination techniques such as direct and remote shall have the capabilities as specified in the procedure. Capabilities include, but are not limited to viewing, magnifying, identifying, measuring, and/or recording observations.

Visual inspection will be performed by using naked eyes. All equipment used for inspection shall be qualified to assure it meets the lighting and resolution requirements of ASME Section V, Article 9.

4.0 PROCEDURE

- Visual examination (Direct) will be conducted in accordance with Section V, Article 9, Procedures IWA-2211 VT-1 and IWA-2213 VT-3 Examination and Table IWA-2210-1.
- VT-1 examination will be conducted to detect discontinuities and imperfections on the surfaces of components, including such conditions as cracks, wear, corrosion, or erosion.
- VT-2 examination will be conducted to detect evidence of leakage from pressure retaining components during the conduct of system pressure test.
- VT-3 examination will be conducted to determine the general mechanical and structural condition of components and their supports by verifying parameters such as clearances, settings, and physical displacements, and to detect discontinuities and imperfections, such as loss of integrity at bolted or welded connections, loose or missing parts, corrosion, wear, or erosion.

5.0 DOCUMENTATION

Documentation shall include all observations and pictures taken. The following information typically will be documented:

- The date of the examination.
- Surface condition as found
- Illumination level
- Type of light source
- Special technique/equipment used.
- Datum points used
- Check list for examination.
- Name and qualification details of person conducting test
- Identification of the part or component examined.
- Signature of person conducting test.

REFERENCE

1. American Society of Mechanical Engineers. 2001. "Rules for Inservice Inspections of Nuclear Power Plant Components," Section XI in The 2001 ASME Boiler and Pressure Vessel Code. ASME International, Washington, D.C.
2. American Society of Mechanical Engineers. 2001. "Rules for Inservice Inspections of Nuclear Power Plant Components," Section V in The 2001 ASME Boiler and Pressure Vessel Code. ASME International, Washington, D.C.

Attachment B-4

LEVEL DRAW DOWN LEAK TEST PROCEDURES FOR VAPOR LIQUID SEPARATOR

B-4-1 BACKGROUND

This procedure provides Leak Test instructions for the Evaporator Recirculation Loop as part of the 242-A Integrity Assessment. The Vessel Integrity Test is being conducted under the overview of an Independent Qualified Registered Professional Engineer (IQRPE). It is not necessary for state inspectors to witness the Integrity Test nor is it necessary to notify the state of the date and time of the test. Results of the Integrity Test will be documented in the final 242-A Integrity Assessment Report (IAR), which will be retained in the in the 242A Evaporator Regulatory File.

The external portions of the components, piping, flanges, welds, and valves will be examined for evidence of leaks. The walk-downs will be performed by a qualified inspector in accordance with ASME Section XI (VT-2) and overseen by the IQRPE or designated QC Level II inspector.

If any leaks are observed, follow-up engineering analysis shall be conducted.

Water will be the process solution used in the Evaporator Vessel CA1 for testing. Integrity testing will be performed after the CA1 Vessel is filled. After testing is complete, the Evaporator vessel will be dumped to 102-AW. Appropriate company procedures and Process Memos should be utilized to carry out these activities.

Total waste generation to tank farms is anticipated to be as follows (3 day estimated testing period):

C-A-1 vessel fill (26,500 gallons)	26,500 gallons
PB1 seal water (7 days * .5 inch per day * 2,750)	9,600 gallons
Potential C-100 PC to 102 AW	5,000 gallons
Total waste generation to tank farms	41100 gallons

B-4-2 INSTRUCTIONS

The test of the evaporation recirculation loop vessels and pipeline can be made in either "Shutdown mode" or at the end of an Evaporator process campaign while the evaporator is being operated in the "Operate mode". Appropriate company procedures should be utilized to establish a stable condition for the recirculation loop system. It is anticipated that the Work Plan for the test will specify at which point in the appropriate company procedure that the evaporator will employ to accomplish the test required in this section. Appropriate company documentation such as Process Memo(s) (e.g. #PM-WFO-07-14), Work Plans, and procedures will be integrated by the company work process to establish the correct conditions for the testing to take place.

The result of the work plan will be to establish a stable condition with the C-A-1 vessel filled to approximately 27,750 gallons or to the levels indicated by associated Process Memos and the Work Plan. The level established during the test activity shall be monitored by either the LIC-CA1-1 or the LIC-CAI-2 liquid level monitors. Whichever indicator is used to determine the initial level must be used throughout the Integrity Test and circled on the Data Sheet

During the testing activity, it is important to note that the PB-1 pump should <u>NOT</u> be operated during this test period.

B-4-2.1 HOLD PERIOD

This level will be maintained for a minimum 24 hour hold period. The vessel level at the start of the 24 hour hold period will be recorded and the vessel level will be monitored every hour on either LIC-CAI-1 or LIC-CAI-2, whichever was circled and recorded on B-4 Data Sheet 1.

The liquid level should remain constant throughout the 24 hour hold period and no additional liquid should be required to maintain the level. Small, erratic up and down variations in liquid level indication may be due to expansion and contraction due to temperature changes or instrumentation effects. This would not be cause for concern. However, a slow steady downward trend in level is more likely to be indicative of a leak.

If the liquid level begins to drop noticeably, notify the 242-A system engineer so an evaluation of the situation may be performed. The system engineer shall decide whether to continue with the leak test. If either criterion listed in section B-4-2.2 is met, the 24 hour hold period shall be terminated and the system engineer notified.

B-4-2.2 ABORT CRITERIA

B-4-2.2.1 The test shall be aborted if three successive hourly increases in the sump level totaling 1 inch or more or a cumulative level rise in the sump of 2 inches or more over the entire 24 hour hold period is observed.

B-4-2.2.2 The test shall be aborted if any visual evidence of a leak as viewed through the lead glass windows of the pump room is observed. Visual observations will be conducted every four hours during the hold period. Results will be recorded on the C-A-1 four hour visual Inspection, B-4 Data Sheet 2.

B-4-2.3 CONDUCT VISUAL EXANINATION FOR LEAKS

After a minimum of 24 hour hold time, drain the evaporator loop to avoid a hazardous deluge condition as follows:

After Integrity Assessment hold test activities are completed, normal operation of the Evaporator with appropriate company procedures can commence to empty the C-A-1 vessel and recirculation loop pipelines.

Following draining of the evaporator loop and establishing safe entry conditions, a qualified inspector (QC Level II) in accordance with ASME Section XI (VT-2) shall inspect the exposed sections of the Evaporator vessel and Reboiler and all connecting piping, flanges, welds, fittings and valves for signs of leakage. Also inspect the SPC floor coating for signs of water accumulation. The QC Level II inspector may examine the components in whatever sequence is most convenient to minimize exposure time in the radiation zone. Items to be inspected and photographed are listed in Attachment B-1. This information is recorded on B-4 Data Sheet 3.

B-4-2.4 ACCEPTANCE CRITERIA

The acceptance criteria for this test are: **NO DETECTABLE LEAKS**.

B-4-2.5 FINAL EXAMINATION

After completion of the visual examination, the system engineer shall review the observations and accept or reject the results (check appropriate blank and sign the attached data sheet).

Subsequently, the QC Inspector shall present the inspection results to the System Engineer and 242A Operations. If all agree that NO leaks have been detected, the 242-A System Engineer shall review the observations and accept or reject the results as identified by signature on B-4 Data Sheet 3.

B-4-3 MISCELLANOUS

Appropriate company procedures shall be utilized to deal with routine and off-normal routine operations during the testing activity.

B-4-4 OSR Rounds

OSR rounds should be performed during the Integrity Assessment in accordance with appropriate company procedures/

B-4-5 REFERENCES

Process Memo #PM-WFO-07-14

B-4 DATA SHEET 1
Evaporator Vessel / Recirculation Loop Level Inspection

Date	Time	Tank Indicator Reading LIC-CA1-1/LIC-CA1-2 Gallons	Recorded By

B-4 Data Sheet 2
4 Hour Visual Observations – C-A-1

Date	Time	Observation	Recorded By

B-4 DATA SHEET 3
EVAPORATOR VESSEL/RECIRCULATION LOOP LEAK TEST VISUAL INSPECTION

Time and date when Vessel was filled: ______________________________

Time and Date when visual inspection began: ______________________________

Observations:

C-A-1 ______________________________

E-A-1 ______________________________

PB-1 ______________________________

Pipeline From C-A-1 to PB-1 ______________________________

Pipeline From PB-1 to E-A-1 ______________________________

Pipeline From E-AZ-1 to C-A-1 ______________________________

Floor ______________________________

Operations Manager: ______________________________

QC Inspectors: ______________________________

Comments: ______________________________

____

____

________ System and components are acceptable based on the inspection results.
No further evaluation is required.

________ System and components require further evaluation.
Reference:

242-A System Engineer: ______________________________ Date:

QC Inspector: ______________________________ Date:

Attachment B-5

LEVEL DRAW DOWN LEAK TEST PROCEDURES FOR CONDENSATE COLLECTION TANK

B-5-1 BACKGROUND

This procedure provides Leak Test instructions for the TK-C-100 as part of the 242-A Integrity Assessment. This test is being conducted under the overview of an Independent Qualified Registered Professional Engineer (IORPE). It is not necessary for State inspectors to witness the test nor is it necessary to notify the State of the date and time or the test. Results of the leak test will be reported to the Washington State Department of Ecology with the final submittal of the 242-A Integrity Assessment.

The external portions of the components, piping, flanges, and valves will be examined for evidence of leaks in accordance with the guidelines of ASME Section XI, Division 1, class 3 (1989) IWA-5240 "Visual Examination (VT-2) and IWD-5000 "System Pressure Tests Visual Examination methods' (VT-2).

B-5-2 PERSONNEL REQUIREMENTS

CH2M HILL personnel will be performing the actual leak testing under the supervision of IQRPE or designated QC Level II inspector. A QC level II inspector shall perform visual inspection of the condensate tank (i.e. inspect the exposed portions of the condensate catch tank and connecting piping).

B-5.3 CONDUCT OF THE TEST

If any leaks are observed, follow-up engineering analysis shall be conducted to identify the type and extent of repairs required.

This test will encompass a fill to just below the High level alarm of the TK-C-100 tank as read on instrument WFIC-C100. The level will be filled to approximately 65% as read on WFIC-C100 per TO-600-190 section 5.3 "Overflow TK-C-100 during shutdown."

The following steps will not be performed in TO-600-190: 5.3.1, 5.3.2, 5.3.6, 5.3.8, and 5.3.10-5.3.13. This procedure is designed to overflow TK-C-100, however, for this leak test, it is only necessary to fill the tank to the approximate 65% level. Perform steps 5.3.3, 5.3.4, 5.3.5, 5.3.7, and 5.3.9 ensuring that the level is only filled to approximately 65% as read on WFIC-C100, NOT AT OVERFLOW LEVELS.

This level will be maintained for a 24 hour hold period. The tank level at the start of the 24 hour hold period will be recorded and the tank level will be monitored every hour on WFIC-C100 and recorded on B-5 Data Sheet 1.

The system operator shall call the QC at the start of the 24 hour hold time. (This call is to provide the QC with an independent verification of 24 hour hold start time.)

Ever four hours the tank will be walked down to determine if leaks are visible or whether liquid is accumulating on the floor of the condenser room, on the pipes, or equipment. Results will be recorded on B-5 Data Sheet 2.

Small erratic up and down variations of liquid level can be due to expansion and contraction due to temperature changes and would not be a cause for concern. However, a steady downward trend in level is more likely to be indicative of a leak.

If the water level begins to drop noticeably meeting the criteria established below, notify the 242-A system engineer so an evaluation of the situation can be made. The System Engineer shall decide if continuing with the leak test is appropriate.

Leak Criteria:

> Decreasing trend in TK-C-100 as read on WFIC-C100 level of 1% or more during the 24 hour hold period;

And

> Any visual evidence of a leak discovered during an inspection of the tank and condenser room floor. Operations shall inspect the TK-C-100 tank every four hours during the hold period.

If no leak is visually verified and level is decreasing, a boundary valve check shall be made to verify integrity and to determine if valves are leaking. The Vessel may be filled to the the same level as previously read on WFIC-C100 as long as the volume added does not exceed 500 gallons (approximately three and one half inches).

B.5.9 CONDUCT VISUAL EXAMINATION FOR LEAKS

After a minimum of 24 hours, the QC inspector shall inspect the exposed portions of TK-C-100, and connected piping, paying particular attention to the welds, joints, and seams. Visual examination will also be performed on the pipe surfaces next to structural supports for evidence of wear caused by vibration. The bottom side of the tank and the associated drain line will also be visually inspected and verified to have no leaks.

The QC will inspect the piping penetrations and flanges associated with process condensate pump PC-100. Reference photograph taken during initial walk-downs. Inspect the bottom side of the TK-C-100 tank by peering through the openings in the bottom support steel. Reference photograph taken during initial walk-downs. Look for any evidence of leaks.

The QC will examine pipe surfaces next to pipe structural supports (e.g., pipe hangers) for evidence of leakage that may have been caused by wear or vibration. Record any leaks and piping section on the data sheet provided.

Operations and QC inspectors will fill out B-5 Data Sheet 3 documenting visual inspection results. Items to be inspected and photographed are listed in Attachment B-1.

B-5-10 FINAL EXAMINATION

After the completion of the visual examination and condensate drain line inspection, the 242-A system engineer shall review the observations and accept or reject the results as identified by signature on B-5 Data Sheet #3.

The acceptance criteria for this test are **NO DETECTABLE LEAKS**.

B-5-11 REFERENCES

ASME - National Board Inspection Code, "A Manual for Boiler and Pressure Vessel Inspectors".

Plan for 242-A Evaporator", WHC-SD-534-0TP-002, Westinghouse

Hanford Company.

WHC QC Surveillance Report #R90-093, and #R90-10S, "Walkdown 242 Evaporator", Westinghouse Hanford Company.

Operational Test Procedure TFPE-WP-01S4, Evaporator/Reboiler, Westinghouse Hanford Company. (From CH2M Hill)

"Quality Assurance Manual", WHC-CM-4-2, Westinghouse Hanford Company. (From CH2M Hill)

"Industrial Safety Manual", WHC-CM43, Westinghouse Hanford Company. (From CH2M Hill)

"Quality Assurance Qualifications and Instructions., WHC-CM..4..S, Westinghouse Hanford Company. (From CH2M Hill)

"Standard Engineering Practices", WHC-CM-6-1, Westinghouse Hanford Company. (From CH2M Hill)

ASME - Rules for Inservice Inspection of Nuclear Power Plant Components, Section XI, IWA-S240 - Visual Examination and IWD-SOOO, VT-2 Inspection.

Operational Test Procedure TFPE-WP-014:7, 242-A Condensate Catch Tank, Westinghouse Hanford Company. From CH2M Hill)

B-5 DATA SHEET 1
Tank C-100 Level Inspection

Date	Time	Tank Water Level WFIC-C100	Recorded By

B-5 Data Sheet 2
4 Hour Visual Observations – TK-C-100

Date	Time	Observation	Recorded By

B-5 DATA SHEET 3
Tank C-100 LEAK TEST VISUAL ISPECTION

Time and date when Vessel was filled:________________________________

Time and Date when inspection began:________________________________

(1) Shell of tank:

____

____

(2) Connections to tank:

(2.1) To P-C-100 isolation valve

____

____

(2.2) To Tank Drain Valve:

____

____

Operations Manager: ______________________________________

QC Inspectors: ____

Comments: ____

____

____

________ System and components are acceptable based on the inspection results.
No further evaluation is required.

________ System and components require further evaluation.
Reference:

242-A System Engineer: ____________________________ Date:

QC Inspector: ____________________________ Date:

ATTACHMENT C

PC-5000 PROCESS CONDENSATE TRANSFER LINE AND ANCILLIARY EQUIPMENT LIST

- **Attachment C-1 List of Components to be Leak Tested for PC-5000 Transfer Line and Ancillary Equipment (2 Sheets)**
- **Attachment C-2 TEST PROCEDURES FOR HYDROSTATIC LEAK TESTING OF PC-5000 PRIMARY TRANSFER LINE WITH WATER**

Attachment C-1
(PC5000 and Ancillary Equipment)

Test		Component ID	Description	Inspection Point	Isolation from (component)	Item to be Photographed	Line Segment Description	Specifications / Materials of Construction	Accessibility / Insulated	P&ID	Maximim/Design Values		Operating Values		Test Pressure	Comments / System Boundary
											Flow/Pressure	Temperature	Operating	Temperature		
Leak Test (PC5000)																
Leak Test	PC5000	3" PC-557-M42	Process condensate	HV-RC3-3	2" PC-556-M42	HV-RC3-3	3" PC-557-M42 from HV-RC3-3 to 3" PC-557-M9 (code change) to 3"PC-557-M9 / 3"-EVAP COND-PC5000-M17 flange.	SCH 40, CS	3" PC line not identified as insulated on P&ID	H-2-98990, SH1; H-2-88766, SH1						
Leak Test	PC5000	3"-EVAP COND-PC5000-M17	Process condensate	Valve at HV-80W-003	3"-WTP-002-M17	Valve at HV-80W-003 (if accessible)	3"-WTP-002-M17 from valve pit valves HV 80W-003 and HV-80-004 to 3"-EVAP COND-PC5000-M17	Centrifugally-cast fiberglass reinforced epoxy pipe	PC5000 & 3"WTP-002-M17; 6" ENC-M17 Valves are accessible at Valve Pit MH-WTP-01	H-2-88766, SH1						HV-80W-003 and HV-80W-004
Leak Test	PC5000	3"-EVAP COND-PC5000-M17	Process condensate	Valve at 60M-43P	NA - continuous section of PC5000 line	Valve at 60M-43P (if accessible)	from valve pit valves HV-80W-001 and HV 80W-002; code change at valves from M17 to M9 and back to M17 after valves to valve 60M-43P.	Centrifugally-cast fiberglass reinforced epoxy pipe	6" ENC-M17, Heat-traced to 4 feet min below grade.	H-2-88766, SH3						
Leak Test	PC5000	3"-EVAP COND-PC5000-M17	Process condensate	NA	NA - continuous section of PC5000 line	Valves HV-43-3, HV-43-4, and HV-43-5 (if accessible)	3"-EVAP COND-PC5000-M17 from valve HV-43-3 to HV-43-5	Centrifugally-cast fiberglass reinforced epoxy pipe	6" ENC-M17, Heat-traced to 4 feet min below grade.	H-2-88766, SH3						
Leak Test	PC5000	3"-EVAP COND-PC5000-M17	Process condensate	Valve at 60M-04A on 3"60M-001-M17	3"60M-001-M17	Valve 60M-04A on 3"60M-001-M17 - (if accessible)	3"-EVAP COND-PC5000-M17 from valve HV-43-3 to HV-43-5	Centrifugally-cast fiberglass reinforced epoxy pipe	6" ENC-M17, Heat-traced to 4 feet min below grade.	H-2-88766, SH3						
Leak Test	PC5000	3"-EVAP COND-PC5000-M17 - 6" Secondary Containment	Process condensate	NA	NA	6" ENC Test Risers - Provided every 100 feet (typical)	3"-EVAP COND-PC5000-M17 - 6" Secondary Containment	6" ENC-M17, Heat-traced to 4 feet min below grade.	6" ENC-M17, Heat-traced to 4 feet min below grade.	H-2-88766, SH3						
Ancillary Equipment																
No Test (Outside System)	PC5000	3"-EVAP COND-PC5000-M17	Process condensate	NA - continuous section of PC5000 line	NA - continuous section of PC5000 line		from valve 60M-43P to HV-43-5. Connection to 3"-60M-001-M17 between valves 60M-43P and HV-43-5, isolated by valves HV-43-3 and HV-43-5.		6" ENC-M17, Heat-traced to 4 feet min below grade.	H-2-88766, SH3						
No Test (Outside System)	PC5000	3"-EVAP COND-PC5000-M17	Process condensate	NA - continuous section of PC5000 line (bypass)	NA - continuous section of PC5000 line (bypass)		Bypass to connection to 3"-60M-001-M17 through valve HV-43-4 (NC)		6" ENC-M17, Heat-traced to 4 feet min below grade.	H-2-88766, SH3						
No Test (Outside System)	PC5000	3"-EVAP COND-PC5000-M17	Process condensate	HV-43-6	8" EVAP COND-PC5005-M17		from valve HV-43-5 through expansion to HV-43-6, connection to line 8" EVAP COND-PC5005-M17		6" ENC-M17, Heat-traced	H-2-88766, SH3						HV-43-6? Size and nomenclature changes from 3" EVAP COND-PC5000-M17 to 8" EVAP COND-PC5005-M17 after exp and vavle HV-43-6.
No Test (Outside System)	PC5000	3"60M-001-M17	Process condensate	Valve at 60M-04A on 3"60M-001-M17	3"-EVAP COND-PC5000-M17		from valve 60M-04A to line 3"-EVAP COND-PC5000-M17		Insulated upstream of valve 60M-04A (6" ENC-M17, heat traced to 3.5 feet min below grade)	H-2-88766, SH3						60M-04A
No Test (Outside System)	PC5000	3"60M-003-M17	Process condensate	Valve at 60M-43F on 3"60M-003-M17	3"-EVAP COND-PC5000-M17		from valve 60M-43F to 3"-EVAP COND-PC5000-M17			H-2-88766, SH3						60M-43F
No Test (Prior to Sys Bndry)	PC5000	3"PC-557-M9	Process condensate				from 242-A evaporator bldg / tank TK-C-100 to unidentified flange at interface between 3"PC-557-M9 and 3"-EVAP COND-PC5000-M17			H-2-88766, SH1						HV-RC-3 last CV / isolation vavle in PC system.
No Test (Prior to Sys Bndry)	PC5000	2"-VE-1050-M9	vent				loop from PC5000 through SRV-1			H-2-88766, SH1						If system cannot be isolated at SRV-1, then no CV or isolation valve shown on line between nozzle J on tank TK-C-100 and connection to condensate line.
No Test (Prior to Sys Bndry)	PC5000	2"-VE-1060-M9	vent				loop through VB-C-1			H-2-88766, SH1						If system cannot be isolated at VB-C-1, then no CV or isolation valve shown on line between nozzle J on tank TK-C-100 and connection to condensate line.
No Test (EHTR / ENC)	PC5000	3/4"-EHTR-M9					from valve 1-18B to 6"ENC of 3"-EVAP COND-PC5000-M17			H-2-88766, SH1						1-18B
No Test (WTP / Future)	PC5000	3"-WTP-002-M17	radioactive effluent (future)				3"-WTP-002-M17 from valve pit valves HV 80W-003 and HV-80-004 (future)			H-2-88766, SH1						HV-80W-003 and HV-80W-004
No Test (ENC)	PC5000	6"ENC Test Riser	test riser				to 6" ENC of 3"-EVAP COND-PC5000-M17	Every 100 feet, typical		H-2-88766, SH1						
No Test (ENC)	PC5000	2"-ENC DR-M17	Enclosure drain				from valve HV-43-2 to 6"ENC of 3"-EVAP COND-PC5000-M17			H-2-88766, SH3						HV-43-2
No Test (Outside System)	PC5000	3"60M-003-M17	Process condensate				from valve 60M-43-F through vavles 60M-43M and 60M-43N to line 8"EVAP COND-PC5100-M17			H-2-88766, SH3						60M-43F (upstream of line connection to 8"EVAP COND-PC5100-M17
No Test (Outside System)	PC5000	Unidenified line					from unidentified flange to valve 60M-430 to 3"60M-003-M17									
No Test (Outside System)	PC5000	8" EVAP COND-PC5100-M17	Process condensate				from valve HV-43-8 to 3"-EVAP COND-PC5000-M17		None indicated on P&ID	H-2-88766, SH3						HV-43-8 and HV-43E (no CV or isolation valve prior to branch between lines 8" EVAP COND-PC5010-M17 and 8" EVAP COND-PC5100-M17

Attachment C-1
(PC5000 and Ancillary Equipment)

Test		Component ID	Description	Inspection Point	Isolation from (component)	Item to be Photographed	Line Segment Description	Specifications / Materials of Construction	Accessibility / Insulated	P&ID	Maximim/Design Values		Operating Values		Test Pressure	Comments / System Boundary
											Flow/Pressure	Temperature	Operating	Temperature		
No Test (Outside System)	PC5000	8" EVAP COND-PC5010-M17	Process condensate				from valve HV-43E to 3"-EVAP COND-PC5100-M17		None indicated on P&ID	H-2-88766, SH3						HV-43-8 and HV-43E (no CV or isolation valve prior to branch between lines 8" EVAP COND-PC5010-M17 and 8" EVAP COND-PC5100-M17
No Test (Outside System)	PC5100	8" EVAP COND-PC5100-M17	Process condensate				from valve HV-43-8 through valve HV-43-9, flexible connection, unidentified flange (code change from M-17 to M-35) to line 14" EVAP COND-M35 / RB-R-43-R to 242 A EVAP COND 242AL-43			H-2-88766, SH3						
No Test (Outside System)		242-A EVAP COND 242AL-43	LERF Basin & ETF Influent Evaporator					6.5 million gallon capacity		H-2-88766, SH3						
No Test (Outside System)		P-43-4	Basin pump					175 gpm		H-2-88766, SH3						
No Test (Outside System)		RB-R-43-5	Basin pump riser				from pump P-43-4 to riser RB-R-43-5			H-2-88766, SH3						
No Test (Outside System)		6"-60M-004-M17					riser RB-R-43-5 through flexible connection to line 6"-60M-004-M17		insulated	H-2-88766, SH3						
No Test (Outside System)		6"-60M-004-M17					6"-60M-004-M17 through valve 60M-10B through 6"X3" reducer through FL/LV/ZT P43-1 through 6"X3" expander through flexible connection through 8"X6" expander through flange (unidentified) through valve HV-43-10 to line 8" EVAP COND-PC5100-M17		insulated from riser to unidentified flange	H-2-88766, SH3						

ATTACHMENT C-2 TEST PROCEDURES FOR HYDROSTATIC LEAK TESTING OF PC-5000 PRIMARY TRANSFER LINE WITH WATER

C-2-1 SCOPE

This test method provides the testing of PC-5000 primary transfer line for leaks by pressurizing the line with water (Pressure Drop Method). This method is used primarily to measure total system leakage because the system is below ground for visual inspection and hazardous in nature. This test is being conducted under the supervision of an IQRPE. The PC-5000 line to be leak tested in this IAP begins at the tie-in to the existing two-inch PC556-M42 line down stream of valve HV-RC3-3, as shown on sheet 2 of drawing no. H-2-98990, 2006, in the 242-A Evaporator building and terminates at approximately line station STA 56+ 47.57 at LERF Basin 43 (Basin 242AL-43) on drawing no, H-2-79614, 1998. Drawing H-2-88766 is a P&ID that shows the pipeline connections and inter-ties. This test encompasses a total pipe run of approximately 5475 feet. Attachment C-1 lists the components to be visually inspected during leak testing. Attachment C-2 lists the components to be leak tested for PC-5000 transfer line.

C-2-2 ACCEPTANCE CRITERIA

Dangerous waste regulations do not specify a performance standard for leak testing for existing tank systems (Ecology 1994, Publication No. 94-114). The pressure decay shall not exceed 2.5% per hour. If the system leaks or fails to retain test pressure, follow-up engineering analysis shall be considered to identify the type and extent of repairs required.

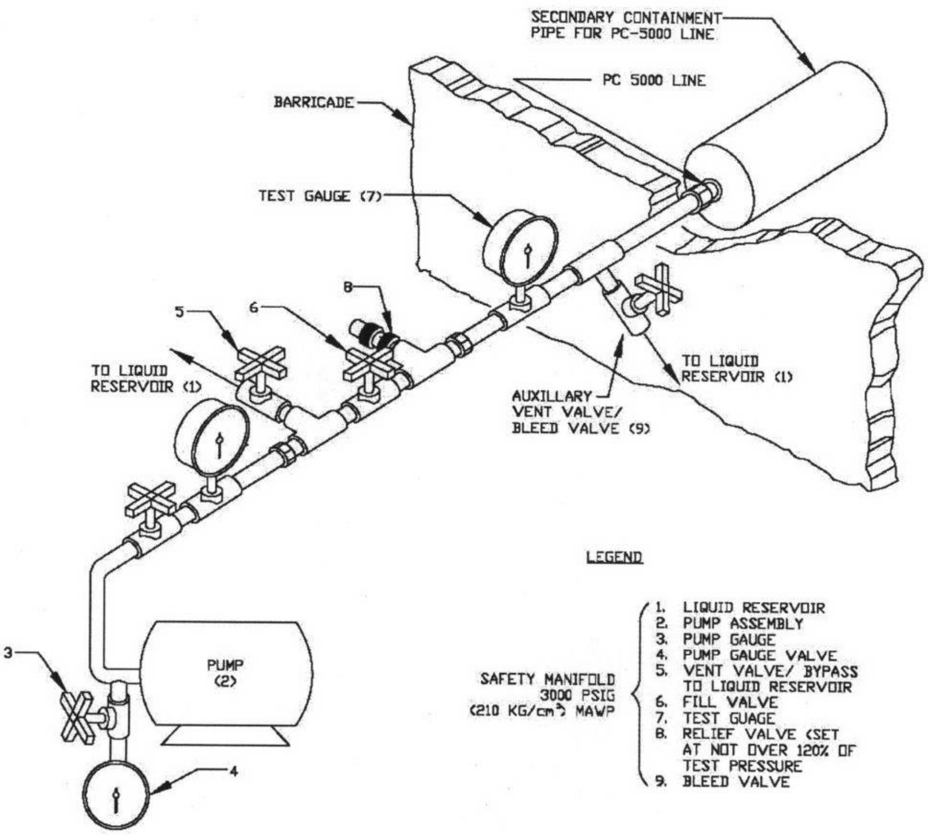
C-2-3 PERSONNEL REQUIREMENTS

CH2M operations personnel will be performing the pressurization and isolations. An IQRPE inspector will verify and record testing procedures and observations.

C-2-4 EQUIPMENT

Liquid reservoir
Pump assembly
Pump gauge
Pump gauge valve
Vent valve (or bypass to liquid reservoir)
Fill valve
Test gauge
Relief valve (set at not over 120% of the test pressure)
Bleed valve at appropriate location
Solution of soap and water

Figure C-2 shows a typical equipment setup for hydrostatic leak testing of PC-5000 primary transfer line with liquid.



LEGEND

SAFETY MANIFOLD 3000 PSIG (210 KG/cm²) MAWP

1. LIQUID RESERVOIR
2. PUMP ASSEMBLY
3. PUMP GAUGE
4. PUMP GAUGE VALVE
5. VENT VALVE/ BYPASS TO LIQUID RESERVOIR
6. FILL VALVE
7. TEST GUAGE
8. RELIEF VALVE (SET AT NOT OVER 120% OF TEST PRESSURE
9. BLEED VALVE

TEST GAUGE MUST HAVE A SOLID FRONT, BLOW-OUT BACK, AND SECURELY ATTACHED PLASTIC FACE IF OVER 4-INCHES IN (100-MM) DIAMETER AND GRADUATED TO OVER 200 PSI (14 KG/cm²). THE SCALE SHOULD BE ABOUT DOUBLE THE TEST PRESSURE AND NEVER LESS THAN 120% OF THE MAXIMUM TEST PRESSURE.

FIGURE C-2-1 TEST SETUP FOR HYDROSTATIC TESTING OF PC-5000 TRANSFER LINE PIPELINE

Drawing Number: C-2-1	COOPER ZIETZ ENGINEERS, INC.	242-A Evaporator Integrity Assessment Hanford Reservation	TechnoGeneral Services Company Engineering and Construction Management	
		SETUP FOR HYDROSTATIC TESTING FOR PC-5000 TRANSFER LINE	DESIGNED BY: XX DRAWN BY: VCAD CHECKED BY: XX	RE-CHECKED BY: XX APPROVED BY: XX DATE: 10 NOVEMBER 2006

REV.	DATE	DRWN	CHKD	REMARKS

REVISIONS

Figure C-2

C-2-5 INITIAL TSD UNIT CONDITIONS

This test requires that the PC-5000 transfer line to be valved at locations described in Attachment C-1, valving off at alternate nearby valves if the selected valves are found to be inaccessible or otherwise blanked off if no other suitable alternative is available

The inner pipe (primary containment) is designed for 100 pounds per square inch (psi) operating pressure; the outer pipe (secondary containment) is designed for 60 psi operating pressure. The maximum operating temperature is 120° F. The test pressure usually is between 75% and 150% of the operating design pressure.

C-2-6 TEST PROCEDURE

This following procedure shall be used as guidance for an actual procedure for hydrostatic leak testing by CH2M operations personnel.

C-2-6-1 Pretest Procedure

The procedure below shall be used for conducting in-place hydrostatic tests; it shall be performed prior to starting the actual test.

- Post "Danger—High-Pressure Test in Progress—Keep Out" signs at all approaches to the test area.
- Seal all openings using plugs that can withstand the test pressure and can be completely removed after the test.
- Components rated at pressures below the test pressure must be isolated.
- Before pressurizing is begun, inspect the line to verify that it is dry and all welds and connectors are exposed if a visual inspection is to be conducted.
- Fill the pump gauge and test gauge with testing liquid, close the pump gauge valve, close the test gauge valve, and assemble as shown in Figure C-2 using components rated at or above the test pressure.
- Remove any test system gauges, or fill them with liquid, and plug openings as required.
- Close the bleed valve, open both the pump gauge valve and test gauge valve, then close the fill valve.
- Check the test system by authorized CH2M personnel for safe testing.

C-2-6-2 Test Procedure

- Open the fill valve and slowly pump to the test pressure by gradually increasing the pressure in the system to 50% of test pressure and make an initial check for leakage. Thereafter slowly increase the pressure to the final test pressure.
- After reaching full pressure check the system to make sure all trapped air has been removed.
- Disconnect the pressure pump and allow the pressure in the system to stabilize for a period of 10 minutes or 5% of the test time whichever is longer.
- After stabilization, record the exact pressure and monitor during the test period.
- If unacceptable leakage is observed (based upon pressure drop), drop the system pressure to zero by opening both the vent valve and fill valve.
- If the leak rate is acceptable, hold the test pressure for the required time by opening the fill valve, pumping as required, and then closing the fill valve. Then open the vent valve, fill valve, and bleed valve to release the pressure; drain liquid from the system.

C-2-7 CONDUCT VISUAL EXAMINATION FOR LEAKS

After a minimum of 10 minutes hold time, QC Level II inspectors shall inspect the exposed portions of the PC-5000 primary transfer line and connecting piping, flanges, and valves for signs of leakage. Use VT-2 data sheets to record observations. The QC Level II inspector may examine the components in whatever sequence is most convenient to minimize exposure time in the radiation zone.

VT-2 examination shall be conducted in accordance with IWA-5000. For direct examination, a maximum examination distance of 6 feet shall apply to the distance from the eye to the surface being examined. Examine accessible surface area of PC-5000 primary transfer line paying particular attention to welds, joints, and seams. Note and photograph areas of leakage. Record inspection results on the checklist.

C-2-8 DATA DOCUMENTATION

The following information will be recorded at the time of the measurements and will be included in the report.

- Date and time test started and test completed
- Test conditions
- Planned test pressure
- Maximum pressure attained
- Leak locations
- Leakage rate
- Test Fluid
- Test personnel qualifications
- Signature of tester

REFERENCES

American Society for Testing and Materials (ASTM) 2000. "Standard Test Method for Hydrostatic Leak Testing." E1003-95, pages 465-467.

ASTM 2000. "Standard Test Method for Leaks Using Ultrasonic." E1002-05, pages 460-463.

American Society of Mechanical Engineers (ASME) 2001. "Rules for Inservice Inspection of Nuclear Power Plant Components." Section XI in The 2001 ASME Boiler and Pressure Vessel Code. ASME International, Washington, D.C.

Environmental, Safety and Health Manual, 2005. "Pressure Testing". Document 18.3 (http:/www.llnl.gov/es_and_h/hsm/doc_18.03/doc18-03.html)